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STAFF APPRAISAL REPORT

ISLAMIC REPUBLIC OF IRAN

SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT

MAY 5, 1992

Infrastructure Division
Country Department II
Middle East and North Africa Regional Office

CURRENCY EQUIVALENT
(As of May 1992)

US$ 1.00	=	Rls 70 1/
Rls 1 00	=	US$ 0.0143 1/
US$ 1.00	=	Rls 1,400 2/
Rls 1.00	=	US$ 0.000714 2/
US$ 1.00	=	Rls 600 3/
Rls 1.00	=	US$ 0.00167 3/

MEASURES AND EQUIVALENT

1 millimeter (mm)	=	0.04 inches
1 centimeter (cm)	=	0.394 inches
1 meter (m)	=	3.28 feet
1 kilometer (km)	=	0.62 miles
1 square kilometer (km^2)	=	0.386 square miles
1 hectare (ha)	=	2.47 acres
1 cubic meter per second (m^3/sec)	=	35.310 cubic feet per second
1 million cubic meters (MCM)	=	35.310 million cubic feet

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

a.m.s.l.	=	above mean sea level
B.C.	=	Before Christ
CBI	=	Central Bank of Iran
CHO	=	Cultural Heritage Organization
DC	=	Direct Contracting
DOE	=	Department of Environment
ERR	=	Economic Rate of Return
FFYP	=	First Five-Year Plan
GDP	=	Gross Domestic Product
GNP	=	Gross National Product
GOI	=	Government of the Islamic Republic of Iran
IAG	=	Inspector and Auditor General
IBRD	=	International Bank for Reconstruction and Development
ICB	=	International Competitive Bidding
IRN	=	Iran
IS	=	International Shopping
LCB	=	Local Competitive Bidding
M&E	=	Monitoring and Evaluation
MEF	=	Ministry of Economic Affairs and Finance
MOA	=	Ministry of Agriculture
MOE	=	Ministry of Energy
O&M	=	Operation and Maintenance
PBO	=	Planning and Budget Organization
PIU	=	Project Implementation Unit
Rls	=	Iranian Rials
RMP	=	Resource Management Program
RWBs	=	Regional Water Boards
SBRWB	=	Sistan Baluchistan Regional Water Board
SDO	=	Sistan Development Organization
WRC	=	Water Research Center

FISCAL YEAR

March 21 - March 20

1/ Official Exchange Rate.
2/ Floating Exchange Rate for Free Market Imports.
3/ Competitive Exchange Rate for a Selected List of Imports.

ISLAMIC REPUBLIC OF IRAN
SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT

STAFF APPRAISAL REPORT

TABLE OF CONTENTS

ANNEXES

MAPS

Approving Regional Vice President:	Mr. Caio Koch-Weser Vice President
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Approving Division Chief:	Mr. Alastair J. McKechnie Division Chief

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This report is based on the findings of an appraisal mission that visited Iran from February 15 to March 8, 1992. Mission members included Messrs. Mario A. Zelaya (Task Manager), Arun Banerjee (Senior Operations Officer), Sheikh A. Rehman (Consultant) and Mmes. Ann Elwan (Senior Economist) and Hoveida Nobakht (Operations Assistant). Peer Reviewers: Messrs. Willem van Tuijl (EMTAG), Nejdet Al-Salihi (MN2AG) and Mrs. Alcira Kreimer (ENVPR).

ISLAMIC REPUBLIC OF IRAN

SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT

Loan and Project Summary

Borrower:	Islamic Republic of Iran
Beneficiary:	The Ministry of Energy (MOE) The Sistan Baluchistan Regional Water Board (SBRWB)
Amount:	US$57 million equivalent
Terms:	17 years, including a five-year grace period,at the Bank's standard variable interest rate.
Project Description:	The key objective of the proposed project is to: (a) reduce the risks to human life and prevent damage to public and private property and infrastructure due to major floods; (b) minimize disruptions to the local economy; (c) provide protection against major floods for habitats and cultural property; and (e) mitigate environmental degradation and health hazards caused by floods and by ad hoc development in the project area. The proposed project consists of: (i) rehabilitating and upgrading about 100 km of dikes along the eastern shore of the Hirmand lake; (ii) rehabilitating and upgrading about 130 km of dikes along both sides of the Sistan river, including river training works, the provision of a bridge across the river and miscellaneous works; (iii) upgrading about 30 km of dikes along the Niatak floodway, including the provision of six bridges and an intake structure; (iv) remodelling the feeder canal to three existing storage reservoirs (at Chahnime depression); (v) developing a rock quarry for rip-rap material; (vi) strengthening project management and support including the maintenance unit; (vii) undertaking physical and mathematical modelling works for river training and operation and maintenance; (viii) providing maintenance equipment and vehicles, a maintenance workshop and a laboratory for testing materials; (ix) providing a program for flood warning and emergency response and for resource management to address environmental, cultural property and social concerns in the project area; and (x) acquiring land for rehabilitating flood control works.
Benefits and Risks:	The project will provide protection against flood damage to public and private property and infrastructure; reduce the risk of loss of human life; and mitigate environmental and cultural property degradation. Project risks associated with SBRWB's lack of knowledge of Bank regulations and guidelines will be addressed through expatriate technical assistance; and risks to works during construction due to major floods will be addressed through proper design, construction management and supervision.

Estimated Project Cost

Component	Local	Foreign	Total
	----US$ million----		
Civil Works	23.4	36.7	60.1
Land	1.4	--	1.4
Proj. Managemt. and Support	3.7	3.4	7.1
Flood Emerg.Plan	1.0	1.5	2.5
Resource Mgt.Prog.	1.5	0.6	2.1
Equip./Mat./Veh.	0.6	4.4	5.0
Total Base Cost	31.6	46.6	78.2
Physical Cont.	2.8	4.2	7.0
Price Cont.	8.6	6.2	14.8
Total Cost	43.0	57.0	100.0

Financing Plan:

	Local	Foreign	Total
	----US$ million----		
Government	43.0	---	43.0
IBRD	---	57.0	57.0
Total Financing	43.0	57.0	100.0

Estimated Disbursements:

	IBRD Fiscal Year						
	1993	1994	1995	1996	1997	1998	1999
Annual	5.6	12.2	11.8	12.4	10.6	4.0	0.4
Cumulative	5.6	17.8	29.6	42.0	52.6	56.6	57.0

Rate of Return: 15 percent

Maps: IBRD No. 23589, 23590

ISLAMIC REPUBLIC OF IRAN
SISTAN RIVER FLOOD WORKS REHABILITATION

STAFF APPRAISAL REPORT

I. INTRODUCTION

General

1.01 The Islamic Republic of Iran has an area of 1.6 million square kilometers (km^2). Administratively, the country is divided into 24 provinces. Iran's population is about 57 million and growing at an annual rate of 3.2 percent. It is a middle-income oil exporting country with an estimated Gross National Product (GNP) per capita equivalent to US$2,450 (1990).1/

1.02 Iran's economic performance during the last decade was mixed, with growth at around 8 percent per annum in the first half of the decade followed by a distinct slowdown as a result of the virtual collapse of oil prices, and severe damage to oil production and export facilities during the war with Iraq. Before the decade closed, Iran began liberalizing the economy, thus laying the basis for an impressive economic recovery now taking place.

1.03 Since 1988/89, GDP growth has picked up and has been strong: 4 percent in 1989 and an estimated 10 percent in 1990. At the same time the economy has stabilized considerably, helped in 1990 partly by the fortuitous increase in oil prices. The government deficit came down from about 9 percent of GDP in 1988, to 4 percent in 1989, and an estimated 2 percent in 1990. As a result of lower deficits, the growth of net credit to Government and, correspondingly, that of broad money declined between 1988 and 1990, helping to lower inflation from 29 percent in 1988, to 17 percent in 1989, and around 10 percent in 1990.

1.04 The project area is located in the Sistan River floodplain, in the Sistan Baluchistan province on the south-eastern side of the country, which is a part of the Hirmand River delta system covering the low land drainage area straddling the border with Afghanistan (See Map 23590). The benefitted population of about 331,000 reside mostly in villages. Zabol, the only urban center, has a population of about 76,000 (para. 2.13). Most of the inhabitants are Sistanis and Baluchis, minority groups who have inhabited the area on both sides of the Afghan-Iranian border for centuries. The main crops consist of wheat, barley, fodder, sorghum, cotton, fruits and vegetables. Farming and livestock breeding are the main economic activities, complemented by rural industries such as rug and carpet weaving. Secondary industries include food products, handmade textiles and basket weaving located mostly in Zabol. Per capita income (1990)1/ from farming averaged about Rls 15,360 (about US$50) and that from services and industry averaged about Rls 130,372 (US$425), which are substantially lower than the national average (para. 1.01).

Rural Flood Damage Mitigation

1.05 The Ministry of Energy (MOE), through its Regional Water Boards (RWBs), is responsible for the provision of flood protection works nationwide. The RWBs are also responsible for the provision of all primary and secondary

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1/ Based on a trade-weighted exchange rate of Rls 307/US$.

irrigation and drainage systems, except for services at the farm level, which are the responsibility of the Ministry of Agriculture (MOA). Generally, engineering design and construction supervision are carried out by consultants retained by the RWBs, and their work is supervised by a consulting engineering firm affiliated with the MOE. The Water Research Center (WRC), a semi-autonomous enterprise also affiliated with the MOE, provides technical support through task-specific contracts for studies and research in the fields of hydrology, hydraulics and sedimentation.

1.06 In the Sistan-Hirmand river delta area, flood protection is managed by a subregional organization, called "Amur-e-Ab", based at Zabol, the district center. This district organization is under the jurisdiction of the "Sistan-Baluchistan Regional Water Board (SBRWB)," which has its headquarters in Zahedan, the provincial capital.

Government Strategy

1.07 The Sistan region is characterized by a very fragile environment and low agricultural productivity; it is inhabited by minority groups living below the poverty threshold. Since the revolution, one of the fundamental policies of the Government of the Islamic Republic of Iran (GOI) has been to provide assistance to underprivileged populations throughout the country. As part of this policy, the GOI provides basic infrastructure and development support in the economically depressed areas of the country to ensure long-term economic gains for sustainable development, and to raise the levels of income of the people living in these areas above the poverty threshold.

1.08 To this effect, the GOI has undertaken a development program in the Sistan region over the last 15 years, consisting of basic infrastructure (roads, communications, schools, an agricultural college, hospitals, irrigation and drainage systems), agricultural extension services, and flood damage mitigation facilities (dikes and ancillary structures). However, the flood protection facilities have proven to be of inadequate capacity because the designs were based on limited hydrological and hydraulic data, and barrages built restricted the hydraulic capacity of the river system. The GOI, in view of the disastrous flood events that occurred in the first quarter of 1991, has broadened its strategy to ensure the long-term development of the area. The strategy is being implemented in two stages: first, undertaking emergency rehabilitation of damaged infrastructure for the protection of the affected population prior to the 1992 flood season; and second, undertaking a program of major rehabilitation and upgrading of flood works designed to ensure protection against the highest recorded flood event in recent history. To coordinate implementation of the long-term strategy, an inter-sectoral coordinating agency, the Sistan Development Organization, was recently established to coordinate, to the extent possible, the development plans and activities of the various ministries active in the area.

Rationale for Bank Involvement

1.09 The GOI is undertaking a major economic restructuring and reconstruction program in an effort to correct economic distortions and to restore and upgrade the infrastructure neglected during the eight-year war with Iraq and further aggravated by natural disasters (earthquakes and

floods). In addition to the foreign currency requirements of this ambitious program, there is also an urgent need to introduce sound technical, economic and environmental criteria in the planning, analysis, design and implementation of projects. Finally, the magnitude of investments in the reconstruction program will require the opening of doors to the international construction industry.

1.10 The GOI has given the proposed project a high priority because it will protect the lives and property of the population, and will permit undertaking economic development programs to improve the quality of life of one of the poorest regions in the country. The proposed project is included in the First Five-Year Plan (FFYP: 1989/90-1993/94). The GOI, in addition to seeking Bank financial assistance for this project, has expressed particular interest in the Bank's experience in a sectoral approach to development planning, in the management of risk mitigation posed by natural hazards and in the management of poverty reduction.

1.11 Bank experience in providing member countries assistance in the reconstruction of fundamental infrastructure seriously affected by natural disasters, particularly those that have caused significant disruptions to a region's economy, in development planning and implementation, and in international procurement will be beneficial to Iran. Bank experience in economic recovery operations will be used in this particular project to introduce economic, social and environmental criteria as a fundamental tool to determine the optimal size and mitigative measures of proposed investments, and to introduce preventive measures through proper planning and through effective emergency response. The proposed project will provide for a flood warning and emergency response program, a project implementation and environmental quality monitoring program and a resource management program to ensure the safety of people and the sustainable economic development of the Sistan region. Given the long hiatus in lending to Iran, and considering the emergency nature of the proposed project and its almost issues-free condition, the proposed operation will give the Bank an opportunity to be responsive to government needs while simultaneously deepening its knowledge through sector work. The Bank lending strategy will address issues related to development policy, institutional and human resources development, environmental planning and management, as well as reduce infrastructure constraints to sustainable economic development in an economically depressed area of the country. The proposed project will contribute to the reduction of poverty in the project area.

II. THE PROJECT AREA

General

2.01 The Sistan plain comprises an area of some 250,000 hectares (ha), of which about 160,000 ha is arable. Range lands in and around the project area amount to about 525,000 ha, out of which about 95,000 ha are located along the fringes of the Hamuns lakes during the dry season (para 2.04). The Sistan Plain is bounded on the east by the Common Parian River, which forms a long section of the border between Iran and Afghanistan; in the north and the west by the Sistan Sink, which includes the Puzak, the Saburi and the Hirmand Hamuns and in the south, by high terraces and the Chahnime depressions. Zabol, the only urban center, is about 205 km from Zahedan (the provincial capital) and 600 km from the Gulf of Oman. It is connected by a two-lane asphalt road to Zahedan, Chabahar and Bandar-e-Abbas ports in the south and to Mashhad in the north.

Physical Setting

2.02 Hydrographic Features. Floods in the Sistan delta and around the sink are caused by the Hirmand River (called Helmand in Afghanistan). The Hirmand begins in the recesses of the Hindu-Kush mountains near Kabul and extends about 1,000 km in Afghanistan. It collects the waters from a vast basin with a surface area estimated at about 275,000 km^2. Most of the drainage area lies in Afghanistan, and a small part in Pakistan. The Sistan sink, however, also receives waters collected from a watershed of about 36,000 km^2 in Iran.

2.03 The Hirmand branches into the Sistan and Parian rivers at the international border (Hirmand fork). The former runs westward across Iranian territory for 60 km until it flows into the Hamun-e-Hirmand (Lake Hirmand). The latter flows northward and empties into the Hamun-e-Puzak which straddles across the Iranian-Afghan border. The changes in the course of the delta rivers are confirmed by abandoned channels such as the Taheri and Shahr which once formed arms of the Sistan River system. Similarly, the Niatak and the Maleki rivers once branched out from the Parian River and traversed the eastern part of the delta.

2.04 In flood years, the water spills from one hamun to the others, turning a series of hamuns or swamps into one colossal lake with a maximum water surface area of about 5,000 km^2 at an average water elevation of about 477 meters (m) above mean sea level (a.m.s.l). This area is reduced to about 600 km^2 in the low-water period when the lake splits into several parts, leaving large stretches of natural pasture (para. 2.01). The lake waters are quite shallow, the average depth being 2 m to 3 m, reaching 5 m in deeper areas during the flood season. The importance of the Hamun-e-Hirmand lies in the fact that it is the only perennial fresh water lake in the region. The lake's inflow is mainly comprised of the waters from the Hirmand River and minor contributions from streams on the northern side of the lake in Afghan territory, as well as those reaching the lake from the west in Iran.

2.05 There is no outflow from the lake in normal flood years because of the lack of a natural outlet and the impermeable nature of its bed. The only significant loss is through evaporation. In exceptionally high flood years, the water spills from the south into the Shile emissary, which carries overflow water into the saline swamps of the Goud-e-Zirre depression in Afghanistan near the Iranian border. The Shile River is about 100 km long, with slightly more than half its length located in Iranian territory. For most of the course, the dry river bed is sunk well below ground level, with an average depth of 8 m to 9 m and a width of 200 m.

2.06 The hydrographic system of the project area includes the three interconnected water storage reservoirs formed by utilizing the natural Chahnime depressions, with a combined surface area of about 36 km^2, at a maximum water elevation of 492 meters a.m.s.l. The combined total and effective capacity of the three reservoirs is estimated at about 700 million cubic meters (MCM). These reservoirs are supplied by a feeder canal with a capacity of 160 m^3/sec located about 0.5 km downstream from the beginning of the Sistan River (Hirmand Fork) at the border with Afghanistan. The reservoirs supply water to the irrigation system to their north.

2.07 Physiography. The Sistan delta uplands are oriented to the southeast and vary in elevation from 500 to 480 meters a.m.s.l. The slope of the plain is somewhat steeper near the apex of the delta and tends to become gentler towards the lake. The average gradient is about 40 centimeters/km. The plain is cut through in many places by what are evidently old river beds. In some cases, human activity in the form of canals and embankments (some later destroyed) have created numerous irregularities in the surface of the plain. The lowest lying areas are found at Chahnime (469 meters a.m.s.l.) and at nearby points, down to a minimum of 459 meters a.m.s.l.

2.08 Climate. The project area has a continental arid type of climate with a hot summer and a fairly cold winter. The mean monthly temperature ranges between 31°C in summer to 10°C in winter, with maximum temperatures reaching as high as 47°C and minimum temperatures going as low as -6°C. Average annual rainfall and pan evaporation amount to about 52 and 4,800 millimeters, respectively. The relative humidity is rather low. The most unfavorable climatic factor specific to the area is the wind, which is intermittent in winter and most constant in summer. The hot blustery winds called "120 days winds" from the north or northwest blow from April to August at velocities of 10 to 20 m/sec.

2.09 Sistan River. The economy of the project area depends primarily on the utilization of the water resources of the Sistan River. The area crossed by the river is the most populated farming area of the delta region. In order to maintain the present level of economic activity and to preserve the environment of the area, protection from the flood hazard inherent in the river flow regime is essential. The main characteristic of the regime is the large annual deviation of the runoff pattern--i.e., 77 percent of annual total runoff flows during the flood season from February to June, and only 23 percent flows during summer to autumn, or the dry season. There is also a remarkable difference in the annual total runoff from year to year, with a maximum of 8,300 MCM and a minimum of 980 MCM. It should be pointed out,

however, that the low flows are greatly determined by water storage reservoirs in Afghanistan, which capture a sizable portion of the flow for irrigation.

2.10 The total length of the Sistan River is about 60 km, over which its altitude drops from around 490 meters a.m.s.l. at the mouth to approximately 474 meters a.m.s.l. at the Hamun. The river passes through the terrace portion of the plain in the upper reaches in a relatively well-defined channel with an average slope of 1:2,500. In the middle reaches of the course it meanders, due to a lesser slope of about 1:5,000. The width of the river ranges from 70 to 400 m. Towards the mouth, the river splits into the Afzalabad and Adimi branches, flowing, respectively, westward and northward around Lorghbagh Island near the river mouth at the Hamun-e-Hirmand.

2.11 The GOI has constructed three barrages on the Sistan River to develop irrigated agriculture. The first, the Kohak barrage, is situated about 2 km below the border; the second, the Zahak barrage is 15 km downstream from the first; and the third, the Sistan barrage is 17 km further downstream from the second. The Kohak barrage is currently being reconstructed because the river bypassed the structure during the 1991 flood by breaching its east flank.

2.12 Irrigation System. The irrigation system in the project area consists of two groups, namely, the Shib Ab and Posht Ab districts. They are supplied with irrigation water from the Sistan River through main canals, located on both banks branching off in front of the Zahak and Sistan barrages. The present irrigable land in the two districts is about 123,400 ha, and planning is underway to increase it by 10,000 ha.

Social and Environmental Aspects

2.13 The total flood plain area has a population estimated at about 331,000 in 1990, increasing at an estimated annual rate of about 3.8 percent. About 77 percent of the population is rural, living in 846 villages ranging in size from 200 to 10,000 inhabitants; the remaining 23 percent, about 76,000 people, live in Zabol, which is the administrative and commercial center of the area. Houses in the villages are typically built of clay and are generally owner-built and occupied. These types of houses are particularly vulnerable to floods, and the resulting damage is often irreparable.

2.14 Farming and stock-rearing are the principal economic activities. Stock-rearing constitutes the traditional pursuit of nomad families, although many of these have become partially sedentary and practice irrigated agriculture along with livestock breeding. The average size of holding per agricultural family is about 4.1 ha. Irrigated agriculture has expanded since 1954 due to the initiative of the GOI in providing the necessary irrigation infrastructure. Nevertheless, the living standard of farmers is very low due to a combination of adverse physical conditions (including poor soil conditions, winds, low rainfall and a high rate of evapotranspiration) and to the poor management of water and soil resources. The full GOI development program for the region includes improved farming and land management techniques, as well as the irrigation schemes described above (para. 2.12) and the flood control works to be provided under the project (para. 3.04).

2.15 There are 526 small industries, which employ about 2,200 persons. Rug and carpet-making is the principal rural industry, employing about 2,000 persons; other secondary rural industries include food products, handmade textiles and basket weaving.

2.16 Zabol and about 76 percent of the villages are provided with piped water from rivers and canals; the remaining villages rely on shallow wells. Water quality, however, is below World Health Organization standards. Public sanitation is nonexistent, and only about 2 percent of the villages are provided with public baths.

2.17 The region's ecology is characterized by a very harsh and fragile environment with flora consisting predominantly of xerophyte (adaptable to dry and hot climate) and halophyte (adaptable to saline soils) vegetation. There are about 14 plant types with many introduced weeds and crops. The fauna population is very rich and includes many threatened and vulnerable species, particularly those of the avian family. The wetland of the Hamuns is a sensitive habitat of international importance for migratory birds, among which there are several rare and susceptible species. The environmental equilibrium is disrupted by periods of drought and floods. Environmental management is the responsibility of the Department of Environment through its regional office in Zahedan and a local office in Zabol. Its mandate is provided under the Environmental Protection and Enhancement Act of 1974.

2.18 The Sistan region is also rich in cultural heritage. Archaeological remains date as far back as 3,200 B.C. (Shahr-e-Soukhte). Cemeteries that contain bones and artifacts are still intact. The area is considered of importance to archaeologists.

Existing Protection Against Floods

2.19 The protection of flood-prone areas in the Sistan plain consists of earth dikes (levees) along both the Sistan River course (about 120 km in total) and the lake shore (about 110 km). There is an almost continuous series of main dikes along the Sistan River downstream of the Zahak barrage and, in some sections, across saddles in the upper reaches. The height of the dikes ranges from 3 to 6 meters, with a variable width at the top of between 4 and 6 meters. In some cases where the main dikes have been attacked by river erosion, short reaches of secondary dikes have also been built. Structural protection measures, such as the provision of riprap or gabions, have not been used in the construction of existing dikes.

2.20 The dikes along the Sistan River were neither properly planned nor designed to withstand recurring floods of the magnitude experienced in 1991. In many sections the dikes are not located at a sufficient distance from the normal river channel to provide an adequate waterway for the passage of flood discharges without causing restriction and excessive velocities. The main river channel, in many places, is either hugging or approaching the dike toe. Furthermore the changes in the river regime levels were not taken into account in the planning and maintenance of existing dikes, and, as a result, no adequate freeboard has been provided. River bed degradation is occurring to a measurable extent on the Sistan River. For these reasons, the dikes along the river failed in various sections during the 1991 flood (para. 2.22), due to

overtopping and/or breaching, resulting in flooding of large areas (para. 2.26). The dike along the lake shore did not fail but was seriously damaged by wave action throughout its length.

Major Flood Events

2.21 Floods in the Sistan Plain are caused by spillage from the river during high flows generated in the upper catchments of the Hirmand River, located entirely in Afghanistan, and by heavy rainfall and snow-melt, which is aggravated by steep gradients, impermeable soils and limited valley storage. The causes and severity of floods in the Hirmand and its main tributary, the Arghandab, are peculiar to the river system. In high flow years, flooding also results along the lake shore and as far inland as the town of Zabol.

2.22 Floods that have caused extensive damage occurred in 1957, 1982 and 1991. The 1957 flood reached a peak of 1,640 m^3/sec, according to the measurements of SBRWB. Flood waters inundated a total area of about 23,000 ha and completely paralyzed the irrigation system of Kokak and Zahak barrages. The 1982 floods were relatively less severe and caused inundation of only about 7,500 ha of agricultural land. In 1991, however, the Sistan River received high flows for almost three months, including the record flow of 2,300 m^3/sec (in February), followed by two more peaks within a period of six weeks, each of about 900 m^3/sec. This flood event caused the worse devastation in the region recorded in recent history; large areas were flooded causing heavy damage to public and private property and infrastructure. The situation was aggravated by flooding from the lake due to high water level and strong northwesterly winds (>100 km/hr.). Floods of relatively less magnitude and adverse impact were recorded in 1989 and 1990, with peak flows of about 1,300 and 1,200 m^3/sec, respectively.

Hydrology and Hydraulic Characteristics

2.23 Since Iran has no access to data on the flood-generating catchments of the Hirmand River located in Afghanistan, the hydrologic data used in this study include actual Sistan River flow records measured in Iran for a period of 41 years (1943, 1948-52 and 1957-91). Also, Hirmand River flow records for a period of 31 years (1891-1921 excluding 1904) from concurrent data of two stations located at Chahar Borjak (some 80 km upstream of the political border) and Payab Sad-e-Kohak (near the border) were correlated with the Sistan River data by synthesizing annual peak discharges. The sample population of annual peak flood flows was screened by tests of the fundamental assumptions governing normality, the most notable exclusion being the 1885 super flood called "Sal Noh-e-Kalan," treating it as an "outlier problem." It reportedly peaked to more than 16,000 m^3/sec at Qale Bist, some 400 km upstream of the border, and might have produced a peak flow of about 6,000 m^3/sec at the head of the Sistan River.

2.24 The frequency analysis was carried out by the use of the annual peak flows for both the time series 1950-91 and 1891-1991. The analysis basically involved the application of Gumbel distribution and Weibull's plotting position formula, although the Log/Pearson III (usually used in USA) and GEV distributions were also tested. However, it was not considered logical to determin floods of different return periods by including the

Hirmand River data because of the unknown source and lack of knowledge about the methodology of measurements and approach adopted for converting the Chahar Burjak peaks to that at the head of the Sistan River. The data of 1943, 1948 and 1949 were also excluded because the remaining data of 1950-91 formed a relatively more homogeneous time series for analysis, as all the figures correspond to post-completion of the Kajaki dam in Afghanistan. According to the other two distributions, the best estimate for the 100 years lies between 2,600 m^3/sec and 3,000 m^3/sec. The selected design flood is only abc.. 2,535 m^3/sec with a return period of 1:100 years using post-1950 data: this is approximately 10 percent greater than the flood peak experienced in 1991. In view of the lack of sufficient hydrological information on the future regime of the Hirmand River and the local factors determining the natural division of the water between the Parian and the Sistan Rivers, the future possibility of peak flows in the Sistan slightly higher than the one recorded in 1991 cannot reasonably be excluded. The results of frequency analysis using Gumbel distribution are given in Table 2.1 below:

Table 2.1: Annual Maximum Peak Discharges of Sistan River

	Peak Discharges (m3/s)			
	1950-91 Series		1891-1991 Series	
Return Period (Years)	Gumbel[1/] Composite	Gumbel[2/] Split	Gumbel[1/] Composite	Gumbel[2/] Split
2.33	545	383	844	889
5	914	876	1,297	1,321
10	1,215	1,278	1,662	1,672
25	1,596	1,785	2,132	2,116
50	1,878	2,162	2,478	2,446
100	2,158	2,535	2,821	2,773
200	2,437	2,908	3,163	3,098

1/ Using available time series in regression analysis.
2/ Excluding values below a 2.33-year return period.

2.25 Keeping in view the design flow of 2,535 m3/s and the present safe discharging capacity of structures across the Sistan River and river reach, as well as the Niatak floodway already constructed, three alternative schemes for flood protection were considered. These alternatives are discussed in Annex 1. The selected alternative offers the least-cost option for the flood control of the Sistan River and was used as the basis for the economic analysis and environmental assessment. This alternative consists of: diverting 435 m3/s to the Chahnime reservoirs, thus routing the balance 2,100 m3/s in the Sistan River up to the Niatak floodway offtake; diverting 600 m3/s through the Niatak floodway; routing the remaining 1,500 m3/s through the Sistan River, as such a flow rate is within the hydraulic capacity of the existing Sistan and Zahak barrages; and routing 1,500 m3/s through the Afzalabad (1,000 m3/s) and the Adimi (500 m3/s) branches, which terminate in Lake Hirmand.

Flood Impact

2.26 Flood damages include direct losses from river spill to standing crops, livestock, irrigation facilities, roads and other infrastructure, and private and public property damage in villages and Zabol. Other losses arise from delays in sowing crops and disruption in transport and communications, from disruptions in economic activities in the service and trade sectors, and from the considerable time and expense involved in relief and rehabilitation work. The maximum areas inundated by high floods of the Sistan River were about 23,000 ha in 1957 and 80,000 ha in 1991. A complete inventory of flood losses is not available, but some data on direct losses supplied by the governorate office are shown in Table 2.2 below.

Table 2.2 Historical Flood Damages in Project Area

Item	Unit	1957	1982	1991
Inundated Area	Ha	23,000	N.A.	80,000
Agriculture	Ha	10,750	7,500	40,675
No.Villages	No.	N.A.	N.A.	215
Houses	No.	2,150	1,410	8,665
Roads	km.	75	54	293
Livestock	No.	4,580	2,650	2,286
Public Buildings	No.	10	6	37
Electricity	km.	N.A.	25	237
Water Supply	Houses	N.A.	962	5,580
Flood Dikes	km.	30	18	62
Farm Channels	km.	4	2	7
Farm Bridges	No.	8	3	N.A.

Source: Governor's Office of Sistan-Baluchistan Province, Zahedan.

III. THE PROJECT

Project Origin

3.01 The Ministry of Economic Affairs and Finance (MEF) first requested Bank assistance for the proposed project of a World Bank mission supervising the Earthquake Recovery Project (Loan 3301-IRN) in May 1991. An identification mission visited the project area in August 1991, and met with the implementing agency and its consultants.

3.02 During the mission, agreement was reached on the composition of the project and an action plan for project preparation. Subsequently, two preparation missions visited Iran in October 1991 and January 1992.

Project Objectives

3.03 The key project objectives are: (a) reduce the risks to human life and prevent damage to public and private property and infrastructure due to major floods; (b) minimize disruptions to the local economy; (c) provide protection against major floods for habitats and cultural property; and (d) mitigate environmental degradation and health hazards caused by floods and by ad hoc development in the project area.

Project Description

3.04 The proposed project consists of: (a) rehabilitating, upgrading and relocating essential flood control works along the Sistan River and Lake Hirmand, and developing a rock quarry for the supply of riprap material; (b) providing training works in the Sistan River; (c) providing a program for early flood warning and emergency evacuation, and for monitoring the performance of flood works and river regime, which would provide protection to the Sistan River flood plain; (d) providing a resource management program for the sustainable development of local resources and the prevention of environmental degradation and social distress; (e) providing maintenance equipment, technical assistance and training for better management of flood control works; and (f) acquiring land for rehabilitating flood control works. The project location and site specific works are shown in maps IBRD No. 23589 and IBRD No. 23590. A detailed description of the proposed flood protection program in the Sistan River flood plain, the early flood warning and emergency response and evacuation program, and the resource management program are given in Annexes 1, 10 and 13, respectively. Main components and key elements supporting the proposed program are given below:

(a) procurement of civil works for: upgrading the Sistan River 130 km flood protection dikes and providing training works; upgrading the 42 km Niatak River with the exception of the first 12 km reach of Niatak floodway built with government funds; improving the capacity of the existing 3.8 km feeder channel to the Chahnime reservoirs; rehabilitating and upgrading of dikes approximately 100 km along the southern shore of Lake Hirmand; providing and upgrading about seven bridges; and developing a rock quarry for the supply of riprap material;

(b) acquisition of land for rehabilitating flood control works;

(c) procurement of equipment for: maintaining the Sistan River, Niatak River and floodway, and Lake Hirmand flood protection works; improving the central workshop located at Zabol; setting up a construction quality control laboratory; and establishing facilities for recording river flow and stage, as well as procuring vehicles and spare parts for new and existing equipment;

(d) provision of institutional strengthening of SBRWB and its sub-regional office in Zabol, consisting of: (i) proper staffing and facilities for both the Project Implementation Unit (PIU), which will be responsible for construction management, monitoring and evaluation (M&E) activities, as well as the special unit dedicated to the maintenance and repair of flood protection works in the project area, and (ii) expatriate experts for the provision of technical services and training, both on-the-job and abroad;

(e) provision of physical and mathematical modelling of the Sistan River for optimizing design and maintenance of flood control and training works;

(f) provision of technical assistance for institutional strengthening of the Sistan Development Organization and of the local offices of the Department of the Environment and the Cultural Heritage Organization. This assistance will be carried out as part of the programs for flood warning and flood emergency response (Annex 10), and for area-wide resource management (Annex 13). The latter program will address aspects associated with: the conservation of wetlands (Lake Hirmand) and habitats of plants and animals and of cultural property, the protection of particularly fragile land resources, and the sustainable development of the region.

Status of Project Preparation

3.05 Project preparation has been carried out by local consulting engineers assisted by expatriate experts. During the course of project preparation, several alternatives were considered, and those selected represent the least-cost solution. Detailed design and tender documents are well advanced, and most contract packages for the initial two years are expected to be completed by July 1992.

Project Cost and Financing

3.06 The total project cost is estimated at about Rls 139.7 billion (US$100.0 million equivalent), of which about Rls 79.2 billion (US$57 million equivalent) or about 57 percent will be foreign costs. Investments will be free of duties and taxes under the prevailing government rules. Project costs, detailed in Annex 2, are summarized by major component in Table 3.1 below:

Table 3.1: Project Cost Summary

Component	Local	Foreign	Total	Local	Foreign	Total
	-----Rls billion----			----US$ million----		
Base Cost:						
Civil Works	32.8	51.2	84.0	23.4	36.7	60.1
Land	2.0	--	2.0	1.4	--	1.4
Proj. Managemt. and Support	5.2	4.7	9.9	3.7	3.4	7.1
Flood Emerg.Plan	1.4	2.1	3.5	1.0	1.5	2.5
Resource Mgt.Prog.	2.1	0.9	3.0	1.5	0.6	2.1
Equip./Mat./Veh.	0.9	6.2	7.1	0.6	4.4	5.0
Total Base Cost	44.4	65.1	109.5	31.6	46.6	78.2
Physical Cont.	3.9	5.7	9.6	2.8	4.2	7.0
Price Cont.	12.2	8.4	20.6	8.6	6.2	14.8
Total Cost	60.5	79.2	139.7	43.0	57.0	100.0

3.07 The cost estimates for the civil works are based on preliminary bill of quantities; February 1992 prices for labor and materials; and an analysis of unit costs of major items of work carried out by the project consultants, supplemented by bid prices for contracts awarded recently by the implementing agency for similar works in the project area; Bank preparation mission estimates; and local costs (in rials) calculated independently from foreign costs (in US$ equivalent). Cost estimates for equipment are based on unit prices of similar equipment procured recently in Iran and on price quotations requested from suppliers. Allowances for physical contingencies have been provided as follows: 10 percent of the base cost for all civil works and land acquisition and 5 percent for all other project components. Price contingencies have been calculated on the basis of a 3.7 percent annual increase from 1992 to 1998 for the foreign cost; and local costs have been assumed to increase at a rate of 12 percent in 1992, 10 percent in 1993, and 8 percent thereafter through 1998 when the project is scheduled to be completed (purchasing power parity is assumed). Total costs (in equivalent currencies) were calculated by converting foreign costs (estimated in US Dollar equivalent) into Rls equivalent and by converting local costs estimated in Rls into US Dollars equivalent by using the "floating exchange rate," which is the prevailing rate at which civil works are priced to reflect the real cost in the local market.

3.08 The financing plan consists of a GOI contribution of Rls 60.5 billion (US$43.0 million equivalent) to cover the entire local cost, plus a Bank loan of US$57 million, corresponding to 100 percent of the foreign exchange requirements.

Procurement

3.09 Procurement will be carried out following International Competitive Bidding (ICB) procedures with prequalification of bidders for major civil works, in accordance with Bank procurement guidelines. Local

Competitive Bidding (LCB) procedures will be used for civil works contracts below US$2.0 million equivalent. The local procedures have been reviewed and are acceptable to the Bank. Goods above a value of US$500,000 equivalent per contract will be procured according to ICB guidelines of the Bank. A limited amount of goods procurement will be done using international shopping and direct contracting procedures. Procurement arrangements are summarized in Table 3.2 below:

Table 3.2: Procurement Arrangements

	Procurement Method (US$M)[1]					
Project Components	ICB	LCB	IS	DC	OTHER	Total
1.Civil Works	57.0	20.6	---	---	---	77.6
	(38.4)	(6.5)	---	---	---	(44.9)
2.Equip./Vehicles	5.0	---	1.0	0.3	---	6.3
	(4.5)	---	(0.9)	(0.3)	---	(5.7)
3.Proj. Management	---	---	---	---	8.7	8.7
Tech. Assist.	---	---	---	---	(3.9)	(3.9)
4.Flood Emergency	---	---	---	---	3.1	3.1
	---	---	---	---	(1.8)	(1.8)
5.Resources Management	---	---	---	---	2.6	2.6
	---	---	---	---	(0.7)	(0.7)
Total	62.0	20.6	1.0	0.3	14.4	98.3
	(42.9)	(6.5)	(0.9)	(0.3)	(6.4)	(57.0)

1/ Figures in parenthesis are the amounts to be financed under the Bank loan. Total project cost excludes procurement of land. Other procurement methods include procurement of consultants.

3.10 The civil works for the Sistan River and Lake Hirmand dikes will be grouped into contract packages, which represent about 73 percent of the total civil works, and will be suitable for procurement under ICB procedures with the prequalification of bidders. ICB contracts will be advertised in groups to enable interested bidders to make offers on a slicing-and-packaging basis, allowing them to offer discounts should they be awarded more than one slice of the package.

3.11 Civil work contracts that will be awarded under LCB procedures include: (i) the Niatak River dikes, which should be completed early in the project period; (ii) the Chahnime feeder canal; and (ii) the Sistan River bridge and risk-prone training works, which will be scattered throughout the river length and carried out in small parcels, depending upon modelling results progressively made available by the Water Research Center and consultants. LCB procedures for these contracts will be consistent with the need for economy and efficiency in the execution of the project. Also, under these procedures, representatives of foreign contractors will be allowed to bid, and all bidders will be treated equally in terms of eligibility for furnishing bids and performance bonds.

3.12 All civil works contracts with construction periods exceeding one year will be subject to local cost escalation. Documents and awards for all ICB contracts and the first LCB contract will be subject to prior review by the Bank. Other ICB contracts exceeding US$1.0 million equivalent will be subject to post-award reviews. LCB contracts below US$1.0 million per contract will be subject to selective post-award review. One set of a sample bidding documents for LCB procurement will be submitted to the Bank for its clearance.

3.13 Contracts for the supply of maintenance equipment, laboratory and miscellaneous supplies and spares, workshop machinery and vehicles, to be grouped into appropriate packages costing more than US$500,000 equivalent will be procured under ICB procedures. Qualified domestic manufacturers will receive a 15 percent (or import duty, whichever is lower) preference in the bid evaluation. However, contracts costing less than US$500,000 equivalent per contract, and not more than US$1.0 million equivalent in the aggregate, will be procured based on comparing at least three price quotations from at least two countries through International Shopping (IS) procedures acceptable to the Bank. Procurement of spare parts for existing equipment amounting to US$0.3 million equivalent, for reasons of standardization and compatibility, will be done following direct contracting (DC) procedures. Documents and awards for all ICB and IS contracts exceeding US$250,000 will be subject to prior review by the Bank.

3.14 Local consultants, assisted by expatriate experts of a foreign consulting firm, have already been retained by the implementing agency and are considered competent for carrying out design. During construction, foreign consultants will be needed to assist the local consultants on the development of the physical and mathematical modelling of the Sistan River, procurement and construction management (Annex 11). The foreign consultants will be recruited in accordance with Bank guidelines. Bank financing will be limited to the foreign cost of such services, which are estimated at about US$3.9 million equivalent.

3.15 Additional expatriate experts will be needed to complement the local consulting firm in carrying out the flood warning, emergency response and evacuation program (Annex 10), as well as the resources management program (Annex 13). These experts will be recruited in accordance with specific qualifications to be provided by the implementing agency and approved by the Bank. These consultants will be recruited in accordance with Bank guidelines. Bank financing will be limited to the foreign cost of such services, which are estimated at about US$2.5 million. The qualifications, experience and contract terms and conditions of local consultants financed by the implementing agency were reviewed and are acceptable to the Bank. Agreement was reached during negotiations that SBRWB will retain local and foreign consultants in accordance with arrangements satisfactory to the Bank throughout project execution.

Disbursement

3.16 The proposed Bank loan of US$57 million equivalent will be fully disbursed in six and one-half years (including six months beyond project completion) against the categories and at rates summarized in Table 3.3 below:

Table 3.3: Disbursement Amounts by Categories

Category Number	Description of Goods or Services	Amount US$ Million	% Expenditures To Be Financed
1.	Civil Works	41.0	100% of foreign expenditures
2.	Equipment	5.0	100% of foreign expenditures
3.	Consultant's Services Training programs, Studies	5.0	100% of foreign expenditures
4.	Unallocated	6.0	
	TOTAL LOAN	57.0	

3.17 Disbursement withdrawal applications will be prepared and submitted to the Bank by the PIU (paras. 4.08 and 4.09). Disbursements against all items will be based on full documentation, except for contracts below US$100,000 equivalent, which will require only statements of expenditures (SOEs). It is estimated that total procurement under SOEs will be about US$1.0 million (about 2 percent of the loan amount). Supporting documents for SOE claims will not be submitted to the Bank but will be retained by the project implementation agency and made available for inspection by Bank supervision missions and project auditors.

3.18 A special account may be set up to finance eligible expenditures under the Bank loan and will follow standard Bank procedures in this regard. The special account will be channelled through a commercial bank to be designated by the Central Bank of Iran (CBI) to which the Bank will make an initial deposit of up to US$2 million. Agreement was reached during negotiations that the GOI may, for the purposes of the project, open and maintain in US dollars a special account on terms and conditions satisfactory to the Bank.

3.19 Also, withdrawals from the proceeds of the loan are expected to be handled through withdrawal applications or through letters of credit. The Bank will accept requests for special commitments and withdrawal applications for a minimum of US$100,000 for direct payment in accordance with the Bank's disbursement procedures.

3.20 Given the long hiatus in lending to Iran, there is no disbursement profile for the country. The implementation period for this project is estimated at six years (July 1992-June 1998) as shown in Annex 4, based on the duration of contracts and construction methods specified, the spread of the works involved and the time-cost relationship. It is anticipated that disbursements will be completed by December 31, 1998, about six months after scheduled project completion. A schedule of estimated disbursements is detailed in Annex 3 and summarized in Table 3.4 below:

Table 3.4: Disbursement Schedule

	IBRD Fiscal Year						
	1993	1994	1995	1996	1997	1998	1999
Annual	5.6	12.2	11.8	12.4	10.6	4.0	0.4
Cumulative	5.6	17.8	29.6	42.0	52.6	56.6	57.0

Project Supervision

3.21 Progress reports will be submitted by the implementing agency within 30 days after the end of each quarter during each year of project implementation. They will focus on progress during the reporting period in the following areas: (a) the performance of surveys and designs for civil works; (b) the bidding process by contract for the procurement of major items of civil works and equipment; (c) the physical achievement by contract of civil works and the delivery of equipment; (d) the status of technical assistance, required studies and programs; (e) the annual work program and budgetary requirements for counterpart funds (March report only); (f) the status of Bank disbursements, including pending withdrawal applications and projected disbursements for the following six months (December and June reports only); (g) the status of covenants, accounts and audit and staff training; and (h) issues raised by Bank supervision missions and their resolutions. A brief summary will be added of reasons for shortfalls under any contract and of actions taken to improve progress.

3.22 Normally, two supervision missions per year for six years (three weeks of Bank staff time each for combined missions) and one supervision in the last year (four staffweeks) will be required during the implementation period to oversee the project. The supervision missions will be generally staffed by an engineer and a financial analyst and consultants, as required to cover expertise in flood works construction, the mathematical modelling of river training and environmental areas. In the first three years, the following will be required: four man-weeks per year of a consultant specializing in the design, construction and maintenance of flood control works and in the procurement aspects of the project; two man-weeks of a consultant specializing in the mathematical modelling of river training; and two man-weeks per year of environmental experts (Annex 5). Initially, four staff-weeks will also be required to familiarize the project staff with the Bank procurement, accounts and audit and disbursement guidelines. On arrival, mission briefings will be held first with the MEF, the MOE and, subsequently, with the chairman, key staff members and project consultants of the implementing agency (SBRWB). The supervision missions will make field visits, as appropriate. Wrap-up meetings will be chaired by a representative of the MEF and attended by representatives of the MOE and the implementing agency. A tentative supervision plan is shown in Annex 5, providing for 13 supervision missions, including a mid-term review. A total of 40 staff-weeks, or about US$240,000, (based on an average cost of US$6,000 per staff-week per mission for combined missions) are estimated for supervision over the life of the project, including the completion report mission.

3.23 A mid-term review of all project activities will be conducted jointly by the MEF/SBRWB and the Bank. To facilitate this review, the MEF/SBRWB will prepare a detailed report covering all aspects of the project and submit it to the Bank by January 15, 1995 for a joint review by March 15, 1995. The project completion report will be prepared by the implementing agency with assistance from the project consultants and submitted to the Bank not later than six months after the loan closing. Agreement was reached during negotiations that the implementing agencies will submit: (a) the quarterly progress reports within 30 days of the closing of each quarter; (b) the detailed progress report for the mid-term review by January 15, 1995; and (c) the project completion report within six months after loan closing.

Monitoring and Evaluation Program

3.24 The project monitoring and evaluation (M&E) program will be carried out by the Project Implementation Unit (PIU), which will be strengthened by staff from the Technical (engineering), Administration/Finance (accounting and personnel administration) and Monitoring/Studies Departments of the implementing agency (see paras. 4.08 and 4.09 for details), assisted by consultants. There will be three subprograms, i.e., the M&E of project performance, as well as the physical characteristics of the Sistan River, the Niatak River and floodway and the Chahnime feeder canal; the M&E of flood warning and emergency response/evacuation; and the M&E of the resources management program. The reporting requirements for the first are discussed in paras. 3.25 and 3.26; and the scope of and reporting on the others is given in Annexes 10 and 13. Progress on these programs will be reviewed by periodic Bank supervision missions (para. 3.22).

3.25 The M&E staff in the PIU will collect and process data about the project's physical and financial performance into a form usable by project management for assessing whether the schedule (Annex 4) and targets set out for project implementation (Annex 6) are being met. The PIU will also quantify changes from the appraisal estimates over the life of the project and recommend changes in project features, when necessary. The head of the PIU will supervise the M&E work and will establish a system for communicating results to the Bank, the Chairman of SBRWB, and the concerned sections in the MOE and MEF.

3.26 The monitoring of the physical characteristics of the Sistan River by the concerned field units will include: daily and monthly flows, corresponding water stages and sediment loads and the annual river survey, including protection dikes and the affected area of the Lake Hirmand following the flood season. Similar surveys will also be performed of the Niatak River and floodway after the routing of floods through it during the high flow period, or once every two years. In addition, all flood protection works will be inspected by a team of field engineers and the findings and recommendations presented in an action-oriented report to ensure that preventive measures were taken. The information received by the M&E staff will be evaluated to determine river behavior, its impact on river training and flood protection works, and the condition and safety of dikes along the river, floodway and lake. An assessment will also be made of costs incurred each year on special repairs, if any, and routine maintenance. This assessment will be used as a basis for preparing annual budget demands for these items. Agreement was reached during negotiations that the SBRWB will undertake a Monitoring & Evaluation Program as indicated in paras. 3.24-3.26.

IV. THE BORROWER AND BENEFICIARY

The Borrower

4.01 The borrower will be the GOI represented by the MEF. GOI will repay the loan and will transfer the proceeds of the loan to the implementing agency for an expeditious execution of the project.

The Beneficiary

4.02 The beneficiaries of the proposed loan will be the Ministry of Energy (MOE) and the Sistan Baluchistan Regional Water Board (SBRWB), which will also be the implementing agency. The MOE is responsible for the generation and distribution of electricity and for the management of water resources throughout the country. Water resources are managed through 14 regional water boards (RWBs), which are established under the provisions of the Law for Establishment of State Corporations and Government Enterprises of the Commerce Code. These Boards enjoy considerable management autonomy. Although overall management functions are provided at the central level through a National Assembly of Water Boards, management functions such as planning, design, construction, monitoring and evaluation and operation are carried out by the RWBs. The MOE, through these RWBs, is responsible for developing water resources for multiple use such as for potable water, the irrigation and generation of electricity, and flood control and drainage. At the farm level, however, the promotion of irrigation and drainage is the responsibility of the MOA. Although the country has not yet developed central sewerage systems, except for a few cities, the management of such services is the joint responsibility of the MOE and the municipal governments through recently enacted legislation for creating Regional Water and Sewerage Companies. An organizational chart of the MOE is shown in Annex 7, Chart A.

The Implementing Agency

4.03 The project will be implemented by the SBRWB under the overall supervision of the MEF. The SBRWB will also be responsible for the operation and maintenance of the proposed works. It will coordinate the project components to be carried out with the close cooperation of other government agencies such as the Department of Environment (DOE), the Cultural Heritage Organization (CHO), the Sistan Development Organization (SDO) and local authorities.

Organization and Management

4.04 The SBRWB was established on April 5, 1970 and is administered under the Articles of Agreement (bylaws) enacted on February 17, 1975 and amended on June 18, 1985. The SBRWB consists of three legal bodies: a General Assembly, a Board of Directors headed by a Chairman of the Board, and an Inspector & Auditor General (IAG). The General Assembly consists of three members: the Minister of Energy, the Minister of Finance and the head of the Planning and Budget Organization (PBO). Normally the ministers and the head of PBO nominate one of their deputies to serve in the General Assembly. The

Board of Directors consists of a chairman and two members (and alternates) who are appointed by the Minister of Energy. The IAG is appointed by the General Assembly and reports directly to it. The Managing Director of the SBRWB is appointed by the General Assembly and generally is also the Chairman of the Board. The Chairman/Managing Director enjoys considerable independence for managing the company within an approved work program and budget. For this reason, management decisions are expeditious, and actions are taken promptly. An organizational chart of the SBRWB is shown in Annex 7, Chart B.

4.05 The SBRWB manages its operations through five branch offices, including the headquarters located in Zahedan, the provincial capital. The organization of each branch office varies according to the level and complexity of services provided and is subdivided in urban and rural departments. The headquarters is organized under five departments as follows: (i) **Administration and Finance**, which, in addition to personnel and administration, is also responsible for maintenance shops, stores, buildings, vehicles and equipment; (ii) **Technical**, responsible for construction, the operation and maintenance (O&M) of water development facilities, irrigation and drainage and flood control works; (iii) **Water Management**, responsible for ground water development and permits and the O&M of water supply in urban areas; (iv) **Planning and Budgeting**, responsible for project design and development; and (v) **Projects and Studies**, responsible for monitoring, data gathering and analysis, and for preparing feasibility studies.

4.06 The SBRWB employs about 1,630 people, of whom about 940 are permanent staff and 690 are under fixed-term contracts. The professional cadre consists of about 60 graduates in geology, economics and finance, mathematics, chemistry, physics, water resources, agriculture, irrigation, mechanical engineering, power engineering and construction management; the remaining staff consists of about 210 with high school diplomas and associate degrees in technical fields, and 1,360 skilled and unskilled workers.

4.07 The Sistan Branch office, which is located in the project area, has a main repair facility for heavy equipment and vehicles. A second repair facility is located at the headquarters in Zahedan to provide support to the other branch offices.

Project Implementation and Management

4.08 At the central level, overall project management will be handled by the PIU located at headquarters in Zahedan, which will be supported by field staff in Zabol. In order to provide the requisite expertise in technical and procurement matters, and to coordinate with the MOE and MEF, a local consultant complemented by an expatriate consultant, has been appointed full-time to assist SBRWB staff in Zabol, Zahedan and Tehran. The MEF will provide support on procurement particularly on matters related to Bank procurement guidelines. The MEF will also supervise project implementation and management to ensure that the project is properly executed. The MEF will also coordinate the relations with the Bank.

4.09 The PIU in Zahedan, which now is responsible for ongoing emergency reconstruction, consists of staff from the Technical Department (engineering). It will be supported by staff from the Administration and Finance Department

(for accounting and personnel administration) and the Monitoring and Studies Department (for monitoring and evaluation studies), and strengthened by consultants (for technical aspects and management of international contracts, Annex 11). The head of the Technical Department will be the PIU chief who will report to the Chairman/Managing Director of the SBRWB. The main responsibilities of the PIU will include: the management of field operations (procurement, payments, monitoring and evaluation, etc.); the supervision of and coordination with project consultants and other government agencies (DOE, CHO, SDO, etc.); the timely implementation of project components particularly the flood warning, emergency response/evacuation and resource management programs; the carrying out of M&E programs (para. 3.24-3.26); the preparation of quarterly progress reports, mid-project reviews and completion reports; the preparation and submission to the Bank of disbursement applications and requests for special commitments; the maintenance and annual auditing of separate project accounts; and the coordination with the Bank particularly during supervision missions (paras. 3.21-3.23). Agreement was reached during negotiations that the Borrower will strengthen the PIU located in the Technical Department, which will be properly staffed and equipped in accordance with arrangements satisfactory to the Bank and as indicated in paras. 4.08 and 4.09 for the implementation of the proposed project.

V. FINANCIAL ASPECTS

Present Situation

5.01 The financial situation of the SBRWB reflects the nature of its operations, the low income levels and living standards of the local population, and dependence on the Government for a substantial proportion of its financial resources.

5.02 The SBRWB provides drinking water to seven areas, i.e., Zahedan, Zabol, Iran-Shahr, Saravan, Nik-Shahr, Chah-Bahar and Kash. The total population in these areas is about 1.5 million, of which it is estimated that about 75 percent are served by the SBRWB. Average water consumption levels are very low. The SBRWB also provides irrigation water to about 124,300 ha of farm land in the Sistan area and to agricultural areas in Iran-Shahr. In addition, the SBRWB undertakes studies for dams, barrages, reservoirs, irrigation and drainage networks, water and drainage systems, and for groundwater utilization and recharge. Funds are provided by the Government to carry out these studies, and once completed, the SBRWB also carries out the construction of the facilities, to the extent that budgetary allocations are made available, and thereafter operates and maintains them.

5.03 The income level of the population in the Sistan area is substantially lower than the national average (para. 1.04). Consequently, the Government has seen fit to set the price of both domestic and agricultural water at low levels. The lowest price for domestic water is Rls 10/m^3 for monthly consumption of up to 10 m^3. Although the highest rate is Rls 40/m^3 for consumption above 100 m^3/month, very few families can afford or have the facilities for such high consumption levels. Water tariff for mosques and public health facilities is Rls 10/m^3; industrial, public and administrative organizations pay Rls 30/m^3; and commercial entities are charged Rls 35/m^3. Water for irrigation through the traditional networks around Zabol, which is unmetered, is provided for Rls 150/ha/year; water supplied through modern networks is charged at Rls 30/m^3.

5.04 SBRWB operational revenues are small, and they come almost entirely from the sale of water. Water supply operations run at a deficit, which are covered by GOI budgetary allocations. The accounting system is rudimentary, and accounts are kept under broad headings. The following table summarizes the operational revenues and expenditures of SBRWB water supply operations for fiscal years 1989/90 to 1992/93.

Table 5.1: SBRWB Expenditure on Projects
(Rls Million)

Item	FY 1989/90	FY 1990/91	FY 1991/92	FY 1992/93
	--------Actual--------		------Projected-------	
Revenues				
Water Sales	552	662	678	720
Other	52	87	142	100
Govt. Subsidy	1070	1235	1430	3280
Total	1674	1984	2250	4100
Expenditure				
Production	1121	1338	1472	2680
Distribution	64	68	74	135
Administration	489	578	704	1285
Total	1674	1984	2250	4100

Future Financial Situation

5.05 As mentioned earlier (in para. 4.02), the RWBs are currently responsible for the provision of water, along with several other water-related services. Until recently there were no municipal sewerage systems in Iran. Construction is only starting in a few major cities, and most is still in the planning and design stage (including Tehran). The responsibility for planning, construction and the operation of the sewerage systems has also been entrusted to the RWBs. Recently, however, the GOI has decided to separate the domestic water supply operations from the RWBs and to establish autonomous Regional Water and Sanitation Companies, which will be responsible for the provision of water supply and sewerage services on a cost recovery basis. The Parliament has enacted the necessary law and it is expected that these companies will be established fairly rapidly.

5.06 Based on the above law, the water supply operations of the SBRWB will be entrusted to a Water Supply and Sanitation Company which will be created for the Sistan Baluchistan province. This is expected to occur within the next couple of years. Thereafter, the SBRWB will be left with the responsibility for planning, construction, operation and maintenance of dams, barrages, reservoirs, irrigation and drainage networks, water and drainage systems, etc, which mostly are nonrevenue producing activities.

5.07 This nonrevenue side of SBRWB operations is poised to grow substantially in the next few years. The limited activities in the past were largely due to the general shortage of investment funds for infrastructural improvements during the war with Iraq; similarly, the dramatic increases foreseen in the next few years reflect the high priority the GOI has given to improving the living conditions of the population in the area. The details of SBRWB investment expenditures in the recent past and its future investment program, are given in Annex 8 and summarized below:

Table 5.2: SBRWB Expenditure on Projects

Fiscal Year	Investments in Rls (Million)			
	Studies*	Construction	Equipment	Total
1989/90 (Actual)	1010	4250	140	5400
1990/91 (Actual)	1723	8587	440	10750
1991/92 (Proj.)	3025	34545	2235	39805
1992/93 (Proj.)	3997	118210	2693	124900

* Includes amounts spent by SBRWB staff for the preparation of these studies.

5.08 Once the responsibility for supplying domestic water is taken away from the SBRWB, its remaining activities, i.e., planning, construction, and operation and maintenance of dams, barrages, reservoirs, irrigation and drainage works, and flood protection works, will be in the nature of public goods. The funds for all of these activities will be provided by the GOI through the annual budgetary process. The income from supplying water for irrigation will be very small. Agreement was reached during negotiations that (a) the GOI will continue to provide the SBRWB sufficient funds on an annual basis for the proper operation and maintenance of all existing and proposed flood control facilities in the project area; and (b) one month prior to the start of each fiscal year, the SBRWB will submit, through MOE, its annual budget for capital investments and operation and maintenance to the Bank for review.

Accounts and Audit

5.09 The SBRWB follows the accounting procedures as set out in the "Law for Establishment of State Corporations/Governmental Enterprises" under which it was established. The accounts are audited by an independent Inspector and Auditor General, who is appointed by the General Assembly and who reports directly to it (para. 4.04). This arrangement is satisfactory. Agreement was reached during negotiations that SBRWB will: (a) keep separate project accounts to record all financial transactions related to the project, including the proposed Statement of Expenditures and the Special Account; (b) have the project accounts audited annually by an independent auditor acceptable to the Bank; and (c) submit through MOE and MEF the audit report to the Bank within six months of the end of each SBRWB fiscal year.

VI. PROJECT JUSTIFICATION

General

6.01 The project will greatly reduce the risk of loss of property and income for large numbers of families living in conditions of poverty and insecurity, and will allow their productivity to increase in the future. It will also greatly reduce the risk of damage to public infrastructure and government buildings. In addition, the project will generate environmental and health benefits that are difficult to quantify. These benefits will be realized using the least-cost combination of project components (para. 3.05); and, when calculated in economic terms, the quantified net project benefits yield a rate of return that is substantially higher than the opportunity cost of capital.

Environmental Impact

6.02 On the expectation that negative environmental impacts from the project will be limited in extent and amenable to mitigation, the project was classified under environmental Category B at the Initial Executive Project Summary (IEPS) stage and subjected to the environmental analysis by Iranian and Pakistani consultants described in detail in Annex 12. This analysis concluded that the proposed project will have a positive impact on both the natural environment and the cultural heritage in the project area through its protection against widespread flood damage. However, since this analysis also identified environmental degradation already taking place in the project area, which, if not addressed could jeopardize the benefits to be accrued from the project, mitigative measures have been included under a Resources Management Program (RMP) (Annex 13 and para. 3.04). This Program will carry out environmental assessments and design studies and provide technical assistance to identify mitigative measures to address increasing water logging, soil salinity and alkalinity, water pollution in the vicinity of larger towns, weed infestation of irrigation and drainage canals, waterborne diseases, wildlife management, desertification and cultural property issues, as well as environmental monitoring needs. The underlying causes--primarily poor soil drainage combined with inappropriate agricultural practices and/or inappropriate sanitation practices--are to a large extent the result of the *ad hoc* nature of the development that has taken place. These conditions are further aggravated by the harsh climatic conditions in the Sistan area (para. 2.08). The RMP, which has been agreed to in principle by GOI, will introduce environmental assessments as a prerequisite to any major investments proposed for the area.

Social Impact

6.03 The project will benefit about 200,000 people living in the Sistan River flood plain, one of the areas targeted by the Government for special assistance. Household incomes in the area are substantially lower than those for the country as a whole (para. 1.04). In the past, various flood cycles caused sedimentation to take place in the lower reaches of the river, changing the river's course. These changes affected irrigation systems, and, together with other forms of flood devastation, precipitated a return to a nomadic

lifestyle for some of the area's residents. In addition to averted costs, therefore, the flood protection and river training components and early warning systems will generate benefits to the area's residents in terms of increased security. This is expected to be manifested in increased stability among the farm families, permitting the optimum use of the infrastructure already put in place by the GOI as part of its special assistance to the region; in addition, this stability will encourage land-use planning and on-farm investments, etc., eventually resulting in higher productivity.

6.04 The project will generate substantial health benefits for the population living in the flood plain. In addition to the health benefits accruing from reduced risk of major floods, the RMP will outline plans for strengthening ongoing Government programs against malaria and schistosomiasis, as well as improving sanitation to address other water borne and vector transmitted diseases, and expanding the pest control management program.

Project Benefits

6.05 The main quantifiable project benefits relate to the reduction in flood-related losses (para. 2.26). Flood-related damage includes losses or partial destruction of irrigation and drainage works, roads and utility networks (water, telephone and electricity), public and private buildings, agricultural equipment and vehicles, livestock, standing crops, stored inputs and products, and losses in future agricultural production while land remains flooded. Additional benefits relate to reductions in the cost of frequent emergency response programs and long-term assistance to the affected population during the period of economic inactivity. Other benefits attributable to the project, but which are generally nonquantifiable, include the reduced risk to human life, reduced health risks and fewer people left homeless.

Economic Analysis

6.06 The economic analysis compares the estimated costs of the flood control and river training aspects of the project to the expected benefits accruing as a result, with both costs and benefits expressed in economic terms. Details of the assumptions for the calculation of the economic rate of return, and for the sensitivity analysis, are given in Annex 9.

6.07 Cost and Benefit Streams. Items included in the cost stream are land, design, civil works, construction supervision and equipment, and the cost of operating and maintaining the works throughout their economic life (50 years). The costs of excavating riprap from a quarry are included as a separate item. Physical contingencies are included at 10 percent for civil works and 5 percent for vehicles and equipment. Cost estimates for the economic analysis are net of taxes. Benefit streams include estimated averted losses of agricultural output, buildings, and infrastructure; savings of expenditures on emergency works, annualized and weighted by probability of occurrence; and estimated increases in crop production of about 5 percent per year due to changes in land use as a result of increased security from flood damage. The residual value of the quarry, after excavation of the material needed for construction of the flood control works, is also included as a benefit.

6.08 Economic Rate of Return. The proposed project will yield an estimated economic rate of return (ERR) of about 15 percent for the base case scenario (based on an economy-wide shadow exchange rate of Rls 920 per US dollar). The estimate is considered conservative in view of the fact that the project's impact on human lives and health, on archaeological sites, and on the natural environment are not quantified. Nor does the ERR include any benefits related to expected improved yields per hectare due to the additional agricultural programs to be implemented by the Government. A sensitivity analysis shows the estimated return to be fairly robust, in that a worst case scenario of a 20 percent increase in costs and a 20 percent decrease in benefits results in an ERR of about 10 percent. The assumption of lower growth in agricultural productivity (3 percent per year instead of 5 percent), decreased the ERR to about 13 percent. A 50-year project life, related to the physical life of the flood protection works, has been assumed; a shorter project life (10 years after completion of construction) reduces the ERR to about 11 percent. The use of the "competitive" exchange rate will yield an ERR of 17 percent.

Project Risks

6.09 Two main project risks are foreseen; namely, those associated with a lack of knowledge of Bank guidelines and regulations, particularly those related to procurement, and risks associated with the normal construction of works of this nature, particularly regarding construction taking place during the flood season. To address the first concern, provisions have been made to provide expatriate consultants familiar with Bank guidelines, and measures will also be taken to provide Bank seminars on procurement, disbursements and on modus operandi; close Bank supervision will also be provided during implementation. To address the second concern, measures have been taken to ensure a sound project design and construction methods that will protect the safety of workers, equipment, structures and work in progress at all times. Risks associated with floods which could exceed the design capacity are being addressed through a flood warning and emergency response program.

Land Requirements

6.10 The Sistan River project will require the acquisition of private property consisting of 1,270 ha of barren and agricultural land and about 15 houses. The acquisition is necessary to relocate existing dikes in some sections along the Sistan River and to upgrade the Niatak River dikes, which mostly will traverse barren desert land. The Government intends to purchase private property at the market value prevailing at the time of acquisition plus additional compensation in kind for hardship. These arrangements are satisfactory to the Bank. Most of the land involved, however, is government-owned, and its acquisition will not affect populated or agricultural areas; only about 15 families in about 5 different areas will be affected who will be relocated within their villages and at nearby villages where Government is building housing and infrastructure (roads, water supply, irrigation and drainage canals) for victims of the 1991 flood. During negotiations agreement was reached that the Borrower will make arrangements satisfactory to the Bank for acquisition of land and relocation, if any, and proper compensation of affected families.

VII. AGREEMENTS REACHED AND RECOMMENDATIONS

7.01 During negotiations, agreement was reached with Government on the following:

(i) that SBRWB will retain local and foreign consultants in accordance with arrangements satisfactory to the Bank through project execution (para. 3.15);

(ii) the GOI may, for the purpose of the project, open and maintain a Special Account in US dollars on terms and conditions satisfactory to the Bank (para. 3.18);

(iii) the implementing agency will submit: (a) the quarterly progress reports within 30 days of the closing of each quarter; (b) the detailed progress reports for the mid-term review by January 15, 1995; and (c) the project completion report within six months after loan closing (para. 3.23);

(iv) the SBRWB will undertake a Monitoring and Evaluation program (para. 3.26);

(v) the Borrower will strengthen the PIU located in the Technical Department which will be properly staffed and equipped in accordance with arrangements satisfactory to the Bank (para. 4.09);

(vi) that: (a) the GOI will continue to provide the SBRWB sufficient funds on an annual basis for the proper operation and maintenance of all existing and proposed flood control facilities in the project area; and (b) one month prior to the start of each fiscal year the SBRWB will submit, through MOE, its annual budget for capital investments and operation and maintenance to the Bank for review (para. 5.08);

(vii) that SBRWB will: (a) keep separate project accounts to record all financial transactions related to the project, including the proposed Statement of Expenditures and the Special Accounts; (b) have the project accounts audited annually by an independent auditor acceptable to the Bank; and (c) submit through MOE and MEF the audit report to the Bank within six months of the end of each SBRWB fiscal year (para. 5.09);

(viii) the Borrower will make arrangements satisfactory to the Bank for the acquisition of land and relocation of people, if any, and proper compensation of affected families (para. 6.10).

7.02 Agreement having been reached on the issues referred to in chapter III through VI of this report, the proposed project will be suitable for a Bank loan of US$57 million equivalent to the Government of the Islamic Republic of Iran under the Bank's standard variable interest rate with a maturity of 17 years, including five years of grace.

ISLAMIC REPUBLIC OF IRAN
SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT

Flood Protection Program

A. Hydrology

1. Floods in the project area are caused by spillage from the Sistan River which is entirely fed by the Hirmand River. At the border between Iran and Afghanistan, the Hirmand bifurcates into the Sistan and Common Parian Rivers. The length of the Hirmand is approximately 1,000 km, and the drainage area 275,000 km^2. Of this some 51,600 km^2 area is drained by the Arghandab River which joins the Hirmand at Qal-eh-Bist, about 400 km above the border. The Hirmand River system is fed mainly with snow and rain falling in the upper catchment areas. The average annual precipitation ranges from approximately 340 mm in the upper reaches to about 125 mm in the lower reaches in the desert area. Over 90 percent of the precipitation occurs from December to May. The maximum peak flood estimated at 17,000 m^3/sec occurred in 1885 at the Qal eh Bist station, giving specific flood discharge of 0.061 $m^3/sec/km^2$. The corresponding peak flood in the Sistan River was probably about 6,000 m^3/sec.

2. From the hydrological point of view the Hirmand, Sistan and Common Parian rivers comprise the principal elements draining the Hirmand River basin. Flood protection and management of the Sistan River, therefore, requires an understanding of the hydrology of the Hirmand River. Nevertheless, hydrologic analysis by the use of regional statistical approach and flood routing procedures is not feasible for the Sistan River because of the lack of information about the flood producing catchment areas and the Hirmand River which lie in Afghanistan. The 1973 agreement between Iran and Afghanistan on sharing of the Hirmand waters stipulate monthly inflows for use by Iran but is not specific about management of flood flows.

3. Two dams, the Khajake and the Arghandab, were constructed in Afghanistan in 1950. The former was built on the Hirmand branch and the latter on the Arghandab branch of the Hirmand River system. In addition, three barrages have also been constructed on the Hirmand River and two barrages on the Arghandab River in Afghanistan. A study of water availability and floods coming to Iran was made before and after the construction of these works. It indicates that annual flow volumes in the post-1950 period have decreased for lower return periods, and show little reduction above 5-year return period.

4. In view of the lack of data about the Hirmand River, flood frequency studies were based on a review of the annual maximum peak discharges experienced in the Sistan River in Iran during the period of record. The available data includes: (a) recorded peak flows of the Sistan River for the years 1943, 1948-49 and 1950-91; and (b) synthesized peak discharge data for

the Sistan River for 1891-1921 period. The latter time series was derived by correlating the Hirmand River data observed in Afghanistan at two stations located within 80 km of the border. Frequency analysis were carried out for both the time series using Gumbel distribution (split above 2.33 year return period and composite) and Weibull's plotting position formula. The data of 1943, 1948 and 1949 were excluded from analysis as the remaining data 1950-91 would form a relatively more homogeneous time series for analysis as all the figures would correspond to post-Khajake dam conditions. For fitting the line, linear regression was carried out between factor "K" and data sorted in descending order. The results using Gumbel split on 1950-91 time series were adopted because: (a) 1891-1921 data could not be verified for correctness; and (b) regression analysis on the points above 2.33 year return period provided required weightage to higher floods. Based on this analysis, the estimated flood peak would be 2,535 m^3/sec for 100-year which was selected as the design flood for the protection works. In addition to Gumbel method, Log Pearson III and GEV distributions were also tested. According to these two distribution, the best estimate for the 100 year flood lies between 2,600 m^3/sec (Log Pearson III) and 3,000 m^3/sec (GEV). Data supporting the analysis and its results are available in the project file.

5. Only a few major floods have occurred during this century; the maximum peak discharge was recorded in February 1991, estimated at 2,300 m^3/sec. The design flood of 2,535 m^3/sec is approximately 10 percent more than the peak discharge experienced in 1991. The future possibility of peak discharge in the Sistan River exceeding the 1991 figure cannot be reasonably excluded, taking into account that:

(a) the historical data may not be adequately reliable due to poor gauging procedures;

(b) the local factors which determine the natural division of the Hirmand waters at the bifurcation may change, inducing more flood flows into the Sistan River; and

(c) the stochastic nature of floods and the lack of knowledge of the hydrometeorological conditions which caused the 1885 flood and of the changes taking place in the Hirmand drainage basin.

B. Flood Routing Plan

6. Three alternatives were considered for routing the design flood of 2,535 m^3/sec and for flood protection works, keeping in view the present safe discharging capacity of operational barrages on the Sistan River and river reach and the under construction the Niatak floodway with design capacity of 600 m^3/sec. The selected plan represents the least-cost solution compared to flood protection works required for routing the design flood through: (a) the Sistan River without any floodway; or (b) the Sistan River with two floodways.

Practical merits and demerits of each alternative were also considered. The principal features of the selected alternative for designing flood protection works are shown in Table 1 below:

Table 1: Routing of Design Flood

Floodway	Reach	Length[1/] (km)	Design Discharge m^3/sec
Sistan River	Head to feeder channel[2/]	0.50	2,535
	Diversion into existing feeder Channel	(3.80)	435
	Feeder channel to Niatak floodway	16.66	2,100
	Diversion into Niatak floodway	(42.00)	600
	Niatak floodway to Sistan fork	20.78	1,500[3/]
	Sistan fork to hamun:[4/]		
	Afzalabad branch	12.50	1,000
	Adimi branch	12.50	500

1/ Approximate length. Figures in parenthesis represent length of features other than Sistan River.
2/ Requires remodelling
3/ Equivalent to present safe discharging capacity of Zahak and Sistan barrages.
4/ Terminal hamuns or lakes.

C. Flood Protection Works

General

7. The flood protection plan against the Sistan River and lake flooding will be limited to the essential works. It includes works being built with Government funds and those to be provided under the project. A complete layout of these works is shown in IBRD Map No. 23590, and a detailed description is given below.

Priority Works Funded by Government

8. The Government-funded works are expected to be completed by September 1992. The main works include the following priority activities:

(a) the restoration of the Sistan River damaged dikes to pre-flood condition at critical locations along the Sistan River (total cost Rls 300M);

(b) the construction of a dike around Zabol town, approximately 20 km in length (total cost Rls 600M);

(c) the first 12 km length of the Niatak floodway excluding four bridges in this reach and the floodway offtake from the Sistan River (total cost Rls 8,300M); and

(d) the works required for river training at critical locations (estimated cost Rls 5,000M).

Principal Features of Project-Financed Works

9. The methods applicable to control flooding from the Sistan River include flood confinement, river training and diversion of part of flood flows through the Niatak floodway. The efforts to prevent flood flows from spreading would be realized by dikes. The dikes would be designed and located to enable the river and the Niatak floodway to carry the design discharge without causing restriction and excessive velocities. In selecting the distance between floodway dikes, both engineering and economic factors were considered. The design of dikes along the lake shore would take into account water levels in the lake (corresponding to the design flood discharge) plus wind-induced surge. Generally, the designed dikes would have a crest width of 6 m, to accommodate the road requirements, freeboard of 1.25 m including allowance for settlement and water/land side slopes of generally 2.5 H: 1.0V and 2.0H:1.0V respectively. The basic design requirements for dikes may be briefly stated as follows: the dikes must be stable, any settlement of dikes or foundations must not be excessive and seepage through or under the dike must be of limited nature. They would be constructed with well-compacted, impervious material locally available. The purpose of river training works, in general, would be to guide the river flow in a manner such that a stable channel will be produced and maintained along a desired alignment.

10. Sistan River. The flood confinement or management works would include:

(a) the upgrading or relocation of the Sistan River existing dikes having a total length of about 80 km with 31 km on the left and 49 km on the right bank, to heights varying from 3.1 to 4.0 m;

(b) the provision or improvement of dikes to heights ranging between 2.0 to 2.5 m along both banks of the Adimi and Afzalabad branches, each approximately 12.5 km long;

(c) the armoring of dikes with stone revetment on the river side for a total length of about 17 km;

(d) the construction of a concrete bifurcation structure at the head of Adimi branch to control discharge to a maximum of 500 m^3/sec; and

(e) the provision of additional box culverts under the approach road embankments of the Zabol-Zahedan road bridge.

11. The present condition of the river will require training works at some locations from its head to the Sistan fork. While the identified locations could be modified depending upon the river behavior over the project life, the estimated quantities of work are not expected to vary beyond ± 10 percent. The river training works mainly consist of channel rectification at present estimated for a total length of about 5.0 km, and protection with stone revetment where necessary. The river training works would generally be designed on the basis of hydraulic model tests.

12. Niatak River and Floodway. The Niatak River and floodway will provide the most needed relief to the Sistan River by diverting part of the design flood. This 42 km long floodway will offtake in front of the Zahak barrage on its right bank, pass through relatively undeveloped area, and outfall into the hamun. The proposed plan will use the abandoned Niatak River channel in the last 30 km length. The project will thus provide excavation as necessary for the construction of suitably spaced dikes along both banks of the 30 km long old river channel. It will also provide the construction of offtake structure and six bridges over the floodway. The flood confining dikes will be tied to the channel being formed with Government funds, and to the dike along the lake shore at the outfall end. The offtake structure will be an open weir of nominally reinforced concrete with the crest designed for expected operating conditions. The length of each bridge is about 90 m. It is proposed to construct concrete bridges with prestressed concrete girder (30 m x 3 m spans).

13. Dike along the South Shore of Lake Hirmand. The existing earth dike along the lake shore is about 110 km in length; it was severely damaged due to wave action during the 1991 flood. The project would provide for the rehabilitation of about 100 km length of the existing dike to pre-flood condition with 6 m crest width, average height of 5 m and water/land side slopes of 3H:1V respectively. The wind velocity considered for the design is 80 km/hr and the effective fetch lengths of 24.5, 38.5 and 52.5 km for various dike reaches. Under these conditions, the criteria of providing minimum freeboard is in accordance with American Society of Civil Engineers (ASCE) recommendations. The project would also provide for: the provision of 0.6 m

thick riprap protection laid on filter material in critical reaches totalling 30 km in length; the placement of gravel of 0.1 m thickness on top of the dike; the placement of 30 cm thick horizontal drainage blanket draining to a vertical drain in sand reaches; and the construction of 14 drainage inlets.

14. Remodelling of the Chahnime Feeder Channel. The channel diverting flood flows to the existing Chahnime reservoirs would be enlarged to accommodate the increased discharge of 435 m^3/sec. The remodelling work would involve the addition of two bays to the intake structure of the channel and enlarging its bed width to 45 m. To fix the design parameters of the remodelled channel HEC-2 computer program has been run under various operating conditions of water levels in the river and Chahnime reservoirs.

Table 1

Islamic Republic of Iran
Sistan River Flood Protection Project
Summary Accounts Cost Summary

	Rials			US $		
	Local	Foreign	Total	Local	Foreign	Total
I. INVESTMENT COSTS						
A. Civil Works						
1. Remodeling Feeder Canal	1631.9	708.5	2340.4	1.2	0.5	1.7
2. Niatak Floodway	7900.5	3385.9	11286.5	5.6	2.4	8.1
3. Hamun lake Dikes	9489.7	28469.2	37959.0	6.8	20.3	27.1
4. Sistan River Works	11709.9	16480.6	28190.5	8.4	11.8	20.1
5. Quarry	2079.4	2181.7	4261.1	1.5	1.6	3.0
Sub-Total	32811.5	51226.0	84037.5	23.4	36.6	60.0
B. Land Acquisition	2000.0	0.0	2000.0	1.4	0.0	1.4
C. Project Mngnt. & Support	5187.6	4681.8	9869.4	3.7	3.3	7.0
D. Flood Warning & Emg. Plan	1400.0	2100.0	3500.0	1.0	1.5	2.5
E. Resources Mngnt. Program	2079.0	891)	2970.0	1.5	0.6	2.1
F. Equipment and Vehicles	890.4	6159.6	7050.0	0.6	4.4	5.0
Total BASELINE COSTS	44368.4	65058.5	109426.9	31.7	46.5	78.2
Physical Contingencies	3855.0	5705.1	9560.2	2.8	4.1	6.8
Price Contingencies	12285.0	8403.4	20688.4	8.8	6.0	14.8
Total PROJECTS COSTS	60508.4	79167.0	139675.5	43.2	56.5	99.8

Values Scaled by 1000000.0 - 3/18/1992 10:41

Table 2

Islamic Republic of Iran
Sistan River Flood Protection Project
Summary Accounts by Year

	Totals Including Contingencies Rials						
	92/93	93/94	94/95	95/96	96/97	97/98	Total
I. INVESTMENT COSTS							
A. Civil Works							
1. Remodeling Feeder Canal	1198.2	1321.5	312.1	0.0	0.0	0.0	2831.8
2. Niatak Floodway	4648.3	7154.1	1803.5	190.0	0.0	0.0	13795.9
3. Hamun lake Dikes	4925.7	9654.0	11351.9	11957.4	7959.8	2472.6	48321.4
4. Sistan River Works	0.0	5478.3	7896.9	10474.3	8750.9	5631.0	38231.5
5. Quarry	1186.9	1615.7	736.0	780.8	828.6	0.0	5148.1
Sub-Total	11959.2	25223.6	22100.4	23402.5	17539.3	8103.6	108328.6
B. Land Acquisition	742.7	1250.4	318.3	224.2	0.0	0.0	2535.7
C. Project Mngnt. & Support	1229.0	3253.9	3092.8	1731.2	1567.2	1597.6	12471.7
D. Flood Warning & Emg. Plan	0.0	924.4	2324.7	1034.9	0.0	0.0	4284.0
E. Resources Mngnt. Program	658.0	2231.0	623.5	0.0	0.0	0.0	3512.5
F. Equipment and Vehicles	1175.2	1146.3	372.2	1993.8	3855.5	0.0	8543.0
Total PROJECT COSTS	15764.2	34029.6	28831.8	28386.6	22962.0	9701.2	139675.5

Values Scaled by 1000000.0 3/18/1992 10:41

Table 3

Islamic Republic of Iran
Sistan River Flood Protection Project
Summary Accounts by Year

Totals Including Contingencies
US $

	92/93	93/94	94/95	95/96	96/97	97/98	Total
I. INVESTMENT COSTS							
A. Civil Works							
1. Remodeling Feeder Canal	0.9	0.9	0.2	0.0	0.0	0.0	2.0
2. Niatak Floodway	3.3	5.1	1.3	0.1	0.0	0.0	9.9
3. Hamun lake Dikes	3.5	6.9	8.1	8.5	5.7	1.8	34.5
4. Sistan River Works	0.0	3.9	5.6	7.5	6.3	4.0	27.3
5. Quarry	0.8	1.2	0.5	0.6	0.6	0.0	3.7
Sub-Total	8.5	18.0	15.8	16.7	12.5	5.8	77.4
B. Land Acquisition	0.5	0.9	0.2	0.2	0.0	0.0	1.8
C. Project Mngnt. & Support	0.9	2.3	2.2	1.2	1.1	1.1	8.9
D. Flood Warning & Emg. Plan	0.0	0.7	1.7	0.7	0.0	0.0	3.1
E. Resources Mngnt. Program	0.5	1.6	0.4	0.0	0.0	0.0	2.5
F. Equipment and Vehicles	0.8	0.8	0.3	1.4	2.8	0.0	6.1
Total PROJECT COSTS	11.3	24.3	20.6	20.3	16.4	6.9	99.8

Values Scaled by 1000000.0 3/18/1992 10:41

Table 4

Islamic Republic of Iran
Sistan River Flood Protection Project
Financing Plan by Foreign Exchange / Local / Taxes
US $

	World Bank	Government	Total
	Amount	Amount	Amount
I Foreign	56.5	0.0	56.5
II Local (Excl. Taxes)	0.0	43.2	43.2
III Taxes	0.0	0.0	0.0
Total Project	56.5	43.2	99.8

Values Scaled by 1000000.0 3/18/1992 10:42

Table 5

Islamic Republic of Iran
Sistan River Flood Protection Project
Table 1. Sistan River Flood Works Rehabilitation
Detailed Cost Table
Rials

	World Bank Financing in US $						
	92/93	93/94	94/95	95/96	96/97	97/98	Total
I. INVESTMENT COSTS							
A. Remodel. of Feeder Canal							
EW Excavation	0.1	0.1	0.0	0.0	0.0	0.0	0.3
EW Fill	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Reinforced Concrete	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Concrete Blocks	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Steel Gates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-Total	0.3	0.3	0.1	0.0	0.0	0.0	0.6
B. Niatak Dykes/Zahak Flood.							
EW Excavation	0.2	0.2	0.0	0.0	0.0	0.0	0.4
EW Fill	0.4	0.5	0.1	0.0	0.0	0.0	1.0
Reinforced Concrete	0.2	0.2	0.1	0.0	0.0	0.0	0.5
Concrete Blocks	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Rip Rap	0.1	0.5	0.1	0.0	0.0	0.0	0.7
Prestressed Concrete	0.0	0.1	0.0	0.0	0.0	0.0	0.1
Sub-Total	1.0	1.4	0.4	0.0	0.0	0.0	2.8
C. Hamun Lake Dikes							
Stripping	0.0	0.1	0.1	0.1	0.0	0.0	0.2
EW Fill	1.1	1.9	2.0	2.0	1.6	0.4	9.0
Riprap	1.2	2.6	3.4	3.5	2.0	0.7	13.3
Gravel Surfacing	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Reinforced Concrete	0.3	0.5	0.5	0.5	0.4	0.2	2.3
Gates	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Sub-Total	2.6	5.1	5.9	6.1	4.0	1.2	24.9
D. Sistan River Works							
EW Excavation (Channel.)	0.0	0.1	0.3	0.5	0.4	0.2	1.4
EW Fill (Dikes)	0.0	1.7	1.5	1.5	1.6	1.6	7.9
Riprap (Dikes)	0.0	0.2	0.8	1.4	1.2	0.6	4.2
EW Excavation (Bridge)	0.0	0.0	0.0	0.0	0.0	0.0	0.1
EW Fill (Bridge)	0.0	0.0	0.0	0.0	0.0	0.0	0.1
R. Concrete (Bridge)	0.0	0.1	0.2	0.2	0.1	0.0	0.5
R. Concrete (Adimi Weir)	0.0	0.1	0.1	0.1	0.0	0.0	0.3
Conc. Blocks (Adimi Weir)	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Riprap (Adimi Weir)	0.0	0.0	0.1	0.1	0.0	0.0	0.2
Prestressed Con. (Adimi)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gates (Adimi Weir)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-Total	0.0	2.2	2.9	3.8	3.4	2.4	14.9
E. Quarry	0.4	0.6	0.3	0.3	0.3	0.0	1.8
F. Land Acquisiton	0.0	0.0	0.0	0.0	0.0	0.0	0.0
G. Project Mngnt. & Support							
FO Manager	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FO Deputy Manager	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FO Engineer	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FO Technicians	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FO Drivers	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FO Admin. & Typist	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FO Computer Operators	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FO Budget & Finance	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FO Foreman	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FO Attendant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TO Engineer	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TO Technicians	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TO Driver	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TO Admin & Typist	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TO Budget & Finance	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TO Attendant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O & M of Vehicles	0.0	0.0	0.0	0.0	0.0	0.0	0.2
O & M of Offices	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Technical Asst. & Train.	0.1	0.7	0.7	0.4	0.3	0.3	2.7
Physical & Math. Modeling	0.3	0.4	0.3	0.0	0.0	0.0	1.0
Sub-Total	0.4	1.2	1.1	0.5	0.4	0.4	3.9
H. Flood Emergency Plan	0.0	0.4	0.9	0.4	0.0	0.0	1.7
I. Resources Mang. Program							
Afforestation Mngnt. Plan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hamun Park Mngnt. Plan	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EA Waste Disposal Site	0.0	0.1	0.0	0.0	0.0	0.0	0.1
EA Channelization Reserv.	0.0	0.1	0.0	0.0	0.0	0.0	0.2

Table 5

EA Wastewater Disposal	0.0	0.1	0.0	0.0	0.0	0.0	0.1
EA Irrigation & Drainage	0.0	0.1	0.0	0.0	0.0	0.0	0.2
Develop Envir. Monitoring	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Sub-Total	0.1	0.4	0.1	0.0	0.0	0.0	0.7
J. Equipment & Vehicles							
Vehicles	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Office & Survey Equipment	0.1	0.2	0.0	0.0	0.0	0.0	0.2
Maintenance of Office Eq.	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Maintenance of Heavy Eq.	0.1	0.1	0.1	1.3	2.4	0.0	4.0
Maintenance of Wks. Eq.	0.0	0.1	0.1	0.0	0.0	0.0	0.2
Maintenance of Lab Eq.	0.3	0.0	0.0	0.0	0.0	0.0	0.3
Maintenance of Hand Tools	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance of Other Eq.	0.1	0.2	0.0	0.0	0.0	0.0	0.4
Sub-Total	0.7	0.6	0.2	1.3	2.4	0.0	5.2
Total INVESTMENT COSTS	5.5	12.2	11.8	12.4	10.5	4.1	56.5
Total	5.5	12.2	11.8	12.4	10.5	4.1	56.5

- Values scaled by 1000000.0 3/18/1992 10:41

Table 5

Islamic Republic of Iran
Sistan River Flood Protection Project
Table 1. Sistan River Flood Works Rehabilitation
Detailed Cost Table
Rials

	Government Financing in US $						
	92/93	93/94	94/95	95/96	96/97	97/98	Total
I. INVESTMENT COSTS							
A. Remodel. of Feeder Canal							
EW Excavation	0.3	0.4	0.1	0.0	0.0	0.0	0.8
EW Fill	0.1	0.1	0.0	0.0	0.0	0.0	0.2
Reinforced Concrete	0.1	0.1	0.0	0.0	0.0	0.0	0.3
Concrete Blocks	0.1	0.1	0.0	0.0	0.0	0.0	0.1
Steel Gates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-Total	0.6	0.7	0.2	0.0	0.0	0.0	1.4
B. Niatak Dykes/Zahak Flood.							
EW Excavation	0.4	0.4	0.1	0.0	0.0	0.0	1.0
EW Fill	1.0	1.2	0.3	0.0	0.0	0.0	2.5
Reinforced Concrete	0.4	0.6	0.2	0.1	0.0	0.0	1.2
Concrete Blocks	0.1	0.1	0.0	0.0	0.0	0.0	0.3
Rip Rap	0.3	1.2	0.2	0.0	0.0	0.0	1.7
Prestressed Concrete	0.1	0.2	0.1	0.0	0.0	0.0	0.4
Sub-Total	2.3	3.7	0.9	0.1	0.0	0.0	7.1
C. Hamun Lake Dikes							
Stripping	0.0	0.0	0.0	0.0	0.0	0.0	0.1
EW Fill	0.4	0.7	0.7	0.8	0.6	0.2	3.4
Riprap	0.4	0.9	1.3	1.4	0.8	0.3	5.1
Gravel Surfacing	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reinforced Concrete	0.1	0.2	0.2	0.2	0.2	0.1	0.9
Gates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-Total	0.9	1.8	2.2	2.4	1.7	0.5	9.6
D. Sistan River Works							
EW Excavation (Channel.)	0.0	0.2	0.7	1.3	1.2	0.6	4.0
EW Fill (Dikes)	0.0	0.6	0.6	0.6	0.7	0.7	3.1
Riprap (Dikes)	0.0	0.1	0.3	0.5	0.5	0.3	1.7
EW Excavation (Bridge)	0.0	0.0	0.1	0.1	0.0	0.0	0.2
EW Fill (Bridge)	0.0	0.0	0.0	0.1	0.0	0.0	0.2
R. Concrete (Bridge)	0.0	0.3	0.5	0.5	0.2	0.0	1.5
R. Concrete (Adimi Weir)	0.0	0.2	0.3	0.3	0.1	0.0	0.9
Conc. Blocks (Adimi Weir)	0.0	0.1	0.1	0.1	0.0	0.0	0.3
Riprap (Adimi Weir)	0.0	0.1	0.2	0.2	0.1	0.0	0.5
Prestressed Con. (Adimi)	0.0	0.0	0.0	0.0	0.1	0.0	0.1
Gates (Adimi Weir)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-Total	0.0	1.7	2.7	3.7	2.8	1.6	12.4
E. Quarry	0.4	0.6	0.3	0.3	0.3	0.0	1.9
F. Land Acquisiton	0.5	0.9	0.2	0.2	0.0	0.0	1.8
G. Project Mngnt. & Support							
FO Manager	0.0	0.0	0.0	0.0	0.0	0.0	0.1
FO Deputy Manager	0.0	0.0	0.0	0.0	0.0	0.0	0.1
FO Engineer	0.0	0.0	0.0	0.0	0.0	0.0	0.2
FO Technicians	0.0	0.0	0.0	0.0	0.0	0.1	0.3
FO Drivers	0.0	0.0	0.0	0.0	0.0	0.0	0.1
FO Admin. & Typist	0.0	0.0	0.0	0.0	0.0	0.0	0.2
FO Computer Operators	0.0	0.0	0.0	0.0	0.0	0.0	0.1
FO Budget & Finance	0.0	0.0	0.0	0.0	0.0	0.0	0.2
FO Foreman	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FO Attendant	0.0	0.0	0.0	0.0	0.0	0.0	0.2
TO Engineer	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TO Technicians	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TO Driver	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TO Admin & Typist	0.0	0.0	0.0	0.0	0.0	0.0	0.1
TO Budget & Finance	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TO Attendant	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O & M of Vehicles	0.0	0.1	0.1	0.1	0.1	0.1	0.4
O & M of Offices	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Technical Asst. & Train.	0.1	0.6	0.7	0.4	0.3	0.3	2.5
Physical & Math. Modeling	0.1	0.2	0.1	0.0	0.0	0.0	0.5
Sub-Total	0.5	1.[illegible]	1.2	0.8	0.7	0.8	5.0
H. Flood Emergency Plan	0.0	0.[illegible]	0.7	0.3	0.0	0.0	1.3
I. Resources Mang. Program							
Afforestation Mngnt. Plan	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Hamun Park Mngnt. Plan	0.0	0.0	0.1	0.0	0.0	0.0	0.1
EA Waste Disposal Site	0.1	0.2	0.0	0.0	0.0	0.0	0.2
EA Channelization Reserv.	0.1	0.3	0.0	0.0	0.0	0.0	0.4

Table 5

EA Wastewater Disposal	0.1	0.2	0.0	0.0	0.0	0.0	0.3
EA Irrigation & Drainage	0.1	0.3	0.0	0.0	0.0	0.0	0.4
Develop Envir. Monitoring	0.0	0.1	0.2	0.0	0.0	0.0	0.3
Sub-Total	0.3	1.1	0.3	0.0	0.0	0.0	1.8
J. Equipment & Vehicles							
Vehicles	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Office & Survey Equipment	0.0	0.1	0.0	0.0	0.0	0.0	0.2
Maintenance of Office Eq.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance of Heavy Eq.	0.0	0.0	0.0	0.2	0.3	0.0	0.5
Maintenance of Wks. Eq.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance of Lab Eq.	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Maintenance of Hand Tools	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance of Other Eq.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-Total	0.1	0.2	0.0	0.2	0.3	0.0	0.9
Total INVESTMENT COSTS	5.8	12.1	8.8	7.9	5.9	2.9	43.2
Total	5.8	12.1	8.8	7.9	5.9	2.9	43.2

- Values scaled by 1000000.0 3/18/1992 10:41

ANNEX 3

Islamic Republic of Iran
Sistan River Flood Protection Project
Disbursement by Financier by Semester
US $

Semester	World Bank Amount	Government Amount	Total Amount
1	2.8	2.9	5.6
2	2.8	2.9	5.6
3	6.1	6.0	12.2
4	6.1	6.0	12.2
5	5.9	4.4	10.3
6	5.9	4.4	10.3
7	6.2	3.9	10.1
8	6.2	3.9	10.1
9	5.3	2.9	8.2
10	5.3	2.9	8.2
11	2.0	1.4	3.5
12	2.0	1.4	3.5
TOTAL	56.5	43.2	99.8

Values Scaled by 1000000.0 3/18/1992 10:42

OF IRAN

SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT
PROJECT IMPLEMENTATION SCHEDULE

Project Components	No. of Contracts	Procurement Method	1992/93		1993/94		1994/95		1995/96		1996/97		1997/98	
			1	2	1	2	1	2	1	2	1	2	1	2
A. Civil Works:														
1. Remodelling of Feeder Channel														
Earthwork	1	LCB	ooooo	oooooo	oooo									
Structures	1	LCB	ooooo	oooooo	oooo									
2. Niatak Floodway:														
Dikes	4	LCB	ooo											
Intake Structure	1	LCB	oooo											
Bridges (6 No.)	2	LCB	ooooo	ooo										
3. Sistan River:														
Dikes	1	ICB	ooo	oooooo	ooooo									
Adimi Branch Structure	1	LCB		ooooo	ooooo									
Box Calverts	1	LCB		oooooo	ooooo									
River Training Works	6	LCB	ooo	oooooo	ooooo									
4. Hamun-e-Hirmand:	(2)													
Dike and Drainage Inlets	1	ICB	ooo	oooooo										
5. Quarry	1	LCB	ooooo											
6. Land Acquisition	N/A	D.C.	ooooo											
B. Procurement of Equipment & Vehicles:														
1. Vehicles	2	ICB	ooooo				oooo							
2. Maintenance Equipment	1	ICB						ooo	oooo					
3. Laboratory	3	LCB/IS	oooo											
C. Flood Emergency Plan/RMP		N/A			oooo									
D. Project Management	N/A	DC/OTH												
E. Technical Assistance & Training	N/A	DC/OTH	-----	------	----									

ooooo Planning, Design & Procurement
Implementation/Delivery
Mobilization
----- Continuation of Activities or Ongoing Activities

Annex 5

ISLAMIC REPUBLIC OF IRAN
SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT

Project Supervision Forecast

Bank Fiscal Year	Staff/Consultant Speciality	Staff Weeks
1993	Civil/Sanitary Engineer	4
	Financial Analyst	2
	Flood Control Consultant	4
	Hydraulic Modelling Consultant	2
	Environmental Consultant	2
1994	Civil/Sanitary Engineer	4
	Financial Analyst	2
	Flood Control Consultant	4
	Hydraulic Modelling Consultant	2
	Environmental Consultant	2
1995	Civil/Sanitary Engineer	4
	Financial Analyst	2
	Flood Control Consultant	4
	Hydraulic Modelling Consultant	2
	Environmental Consultant	2
1996	Civil/Sanitary Engineer	4
	Financial Analyst	2
1997	Civil/Sanitary Engineer	4
	Financial Analyst	2
1998	Civil/Sanitary Engineer	4
	Financial Analyst	2
1999	Civil/Sanitary Engineer	2
	Financial Analyst	2

ANNEX 6

ISLAMIC REPUBLIC OF IRAN

SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT

Project Implementation Program and Monitoring Indicators

Project Implementation Program

	Actions	Target Date	Done By
1.	Complete Tender Documents for First Group of CW	June 30, 1992	SBRWB
2.	Strengthen the PIU	Sept. 1, 1992	SBRWB
3.	Start Monitoring and Evaluation Program	Sept. 1, 1992	SBRWB
4.	Submit to Bank Land Acquisition Program for Review	Sept. 1, 1992	SBRWB/MEF
5.	Start Land Acquisition	Sept. 30, 1992	SBRWB
6.	Submit First Progress Report	December 31, 1992	SBRWB/MEF
7.	Provide Bank a Copy of the Operation & Maintenance Budget	Feb. 20, 1993	MEF
8.	Submit First Annual Audit Report of Project Accounts	Sept. 30, 1993	SBRWB/MEF
9.	Submit Mid-Term Progress Report	Jan. 15, 1995	SBRWB/MEF
10.	Submit Project Completion Report	March 31, 1999	SBRWB/MEF

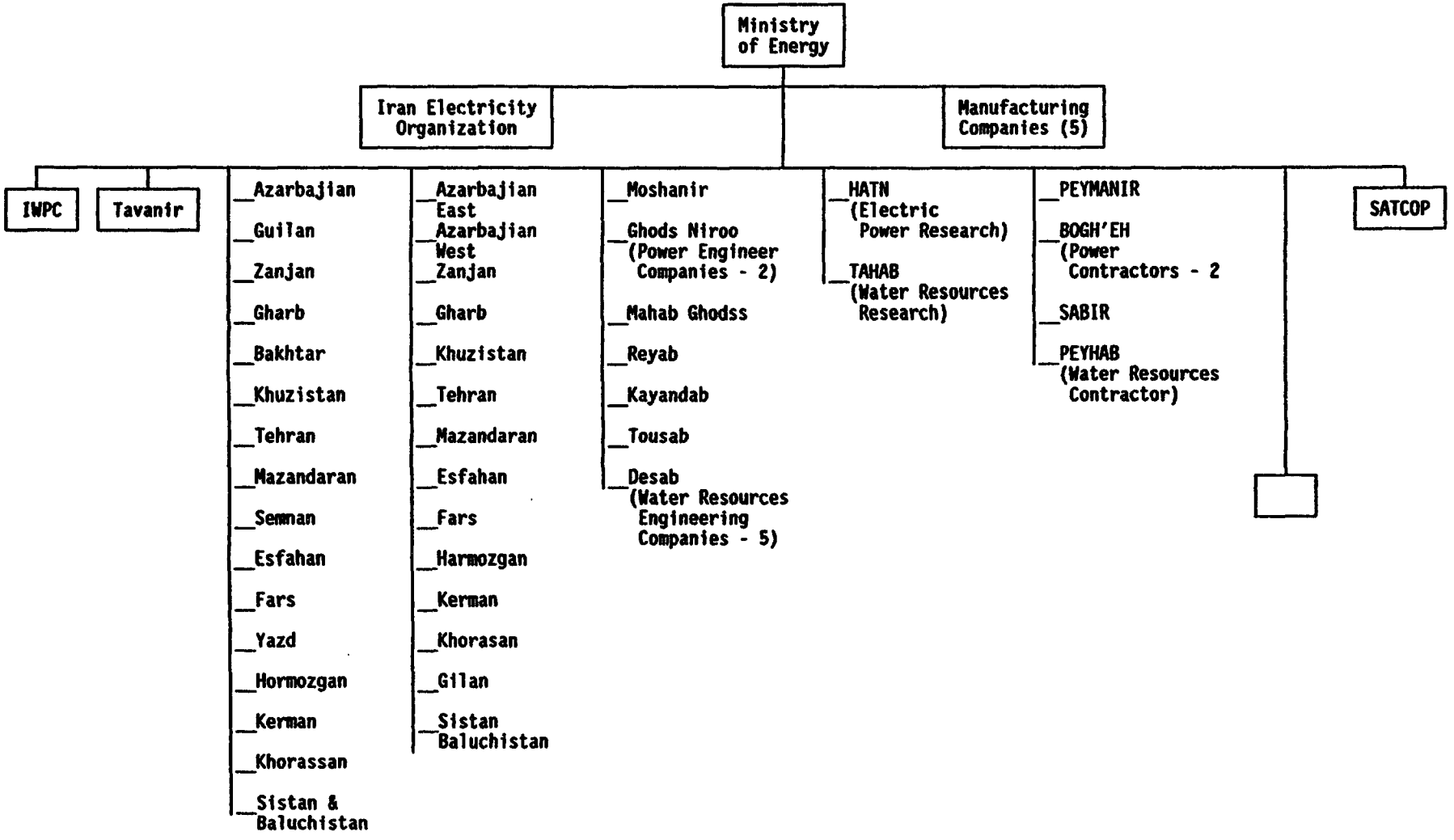
Monitoring Indicators

	Indicators	Target Date
1.	Contract Award/Signing (Major Contracts):	
	(a) Niatak River dikes	Nov. 30, 1992
	(b) Quarry	Dec. 31, 1992
	(c) Sistan River and Lake Hirmand dikes Sistan River Training Works	Dec. 31, 1993
2.	Completion of Major Contracts	
	(a) Niatak River dikes	June 30, 1994
	(b) Sistan River Training Works (1st Contract)	Dec. 31, 1994
	(c) Lake Hirmand dikes	June 30, 1997
	(d) Sistan River dikes and Quarry	Oct. 31, 1997
3.	Prepare Action Plan for Implementation of Flood Warning/Response and Resources Management Program	June 30, 1993
4.	Establish Sistan River Monitoring Stations	June 30, 1993
5.	Prepare Maintenance Program	Dec. 30, 1993
6.	Start Implementation of Flood Warning/Response and Resources Management Programs	Jan. 1, 1994
7.	Complete Implementation of Flood Warning/Response and Resources Management Program	Dec. 31, 1995

ISLAMIC REPUBLIC OF IRAN

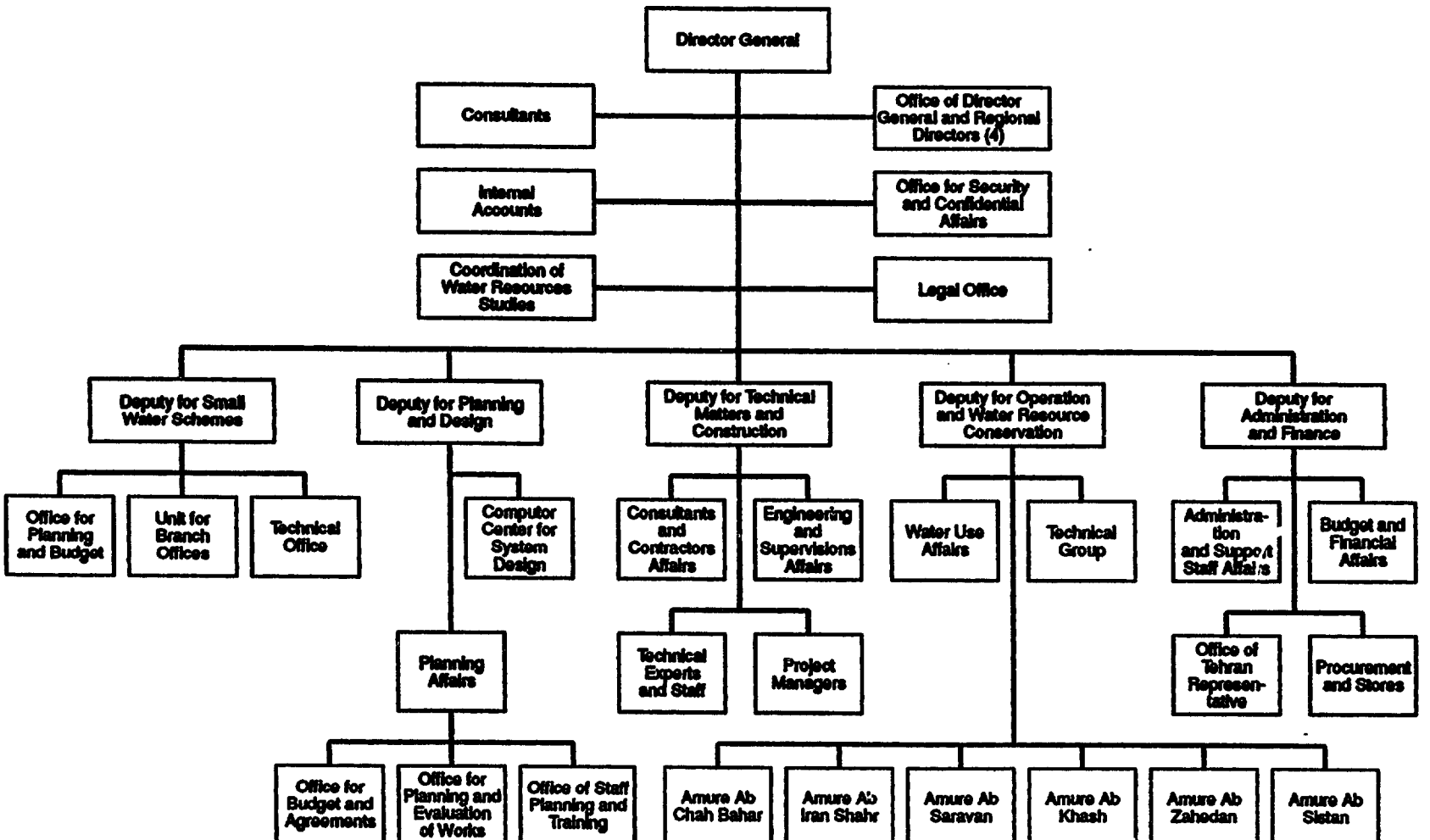
SISTAN RIVER FLOOD CONTROL WORKS REHABILITATION PROJECT

MINISTRY OF ENERGY ORGANIZATION



ANNEX 7
CHART A

ISLAMIC REPUBLIC OF IRAN
SISTAN - BALUCHISTAN REGIONAL WATER BOARD
Organization Chart



ANNEX 7
CHART B

ANNEX 8

ISLAMIC REPUBLIC OF IRAN
SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT
SBRWB INVESTMENT PROGRAM (FY 1989/90 - 1992/93)
(Millions of Rials)

Project	Studies	Construction	Equipment	Total
FY 1989/90				
Hirmand River	70	230	80	380
Water Sources	120	-	-	120
Water Networks	295	1180	25	1500
Irrigation Network	260	415	25	700
Pishin Dam	210	2090	-	2300
Zabol Drainage	55	335	10	400
Total	1010	4250	140	5400
FY 1990/91				
Hirmand River	230	220	50	500
Water Sources	100	-	-	100
Water Networks	410	2470	120	3000
Irrigation Network	275	1375	250	1900
Pishin Dam	210	3690	-	3900
Zirdan & Kahir Dams	400	-	-	400
Zabol Drainage	63	387	-	450
Bahukalat Dam	35	445	20	500
Total	1723	8587	440	10750
FY 1991/92				
Hirmand River	270	570	60	900
Water Network	490	3510	200	4200
Irrigation Network	340	4460	200	5000
Pishin Dam	225	13185	90	13500
Zirdan & Kahir Dams	730	750	20	1500
Zabol Drainage	140	715	45	900
Bahukalat Dam	130	1550	120	1800
Emergency Flood Works	700	9800	1500	12000
Total	3025	34545	2235	39805
FY 1992/93				
Hirmand River	550	11340	110	12000
Water Network	880	32500	620	34000
Irrigation Network	560	20970	470	22000
Pishin Dam	235	16740	25	17000
Zirdan & Kahir Dams	837	7000	63	7900
Zabol Drainage	185	16150	665	17000
Bahukalat Dam	150	6710	140	7000
Emergency Flood Works	600	6800	600	8000
Total	3997	118210	2693	124900

ISLAMIC REPUBLIC OF IRAN

SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT

Economic Analysis

1. The economic analysis compares the estimated costs of the flood control and river training aspects of the project to the expected benefits, with both costs and benefits expressed in economic terms. The economy-wide shadow exchange rate was used throughout the analysis.

Estimation of Costs

2. Capital cost items included in the analysis are those related to land, design and supervision, civil works, and vehicles and equipment. Land costs are calculated on the basis of the number of plots that need to be acquired, the class of land according to its suitability for agriculture, and the market price for the land. Five residential plots will also have to be acquired, and they are also valued at market price. The total land cost is Rl 2000 million. Land acquisition is assumed to take place according to the construction schedule.

3. The costs of excavating rip-rap from a quarry are included as a separate item. Physical contingencies are included at 10% for civil works and 5% for vehicles and equipment. The cost of operating and maintaining the works throughout their economic life (50 years) is also included; and this cost stream includes the replacement of maintenance vehicles over the entire period. Cost estimates are net of taxes for the economic analysis.

Estimation of Benefits

4. The main quantifiable project benefits relate to the reduction of the risk of flood-related losses. Included are losses or partial destruction of irrigation and drainage works, roads and utility networks (water, telephone, and electricity), public and private buildings, agricultural equipment and vehicles, livestock, standing crops, stored inputs and products, and losses in future agricultural production while land remains flooded. Additional benefits relate to reductions in the cost of frequent emergency response programs and long-term assistance to the affected population during the period of economic inactivity. The residual value of the quarry, after excavation of the material needed for construction of the flood control works, is also included as a benefit.

5. The losses are estimated in five categories: (i) agricultural output; (ii) damage to housing; (iii) road damage; (iv) other direct damage, including damage to dikes, irrigation systems and other infrastructure, livestock, etc.; and (v) indirect damages, including damage due to disruption in irrigation and other services, and costs of emergency systems. Each of these is estimate

per hectare, for the design flood. Total damage from selected flood events were calculated for the "with" and "without" project scenarios to establish a damage frequency relationship. These are then converted to average annual damages expected in any given year for all levels of flooding.1/

Assumptions used in the Calculations

6. The estimates of flood damage to crops are based on the revenues per hectare of the various crops grown in the Sistan area, net of input costs. All estimates are calculated in terms of market prices, and adjusted to international prices using appropriate conversion factors. The resulting net potential flood losses are as follows:-

(figures in Rls '000)

Crop	%	Damage Potential	Feb	Mar	Apr	May	Jun
Wheat	34.8	yield loss (%)	100	100	100	100	--
		damages/ha	236.9	285.4	287.7	306.1	--
Barley	16.9	yield loss (%)	100	100	100	100	--
		damages/ha	145.4	177.9	180.0	196.8	--
Melons	10.7	yield loss (%)	--	100	100	100	100
		damages/ha	--	512.4	684.9	781.6	835.9
Alfalfa	3.9	yield loss (%)	100	100	90	80	75
		damages/ha	258.7	264.9	271.3	217.5	147.1
Fruits	1.0	yield loss (%)	100	100	90	80	75
		damages/ha	974.7	974.7	974.7	1035.0	1115.5
Total damages/ha flooded/month:			118.1	185.2	215.4	232.9	96.3
Probability of flood in month:			.09	.12	.27	.35	.17
Total weighted damages/ha:			188.9				

For the total cultivated area covered by the project, 123,400 hectares, total damages amount to Rls 23,310 million.

7. Flood damage to houses is also estimated on a per hectare basis. There are an estimated 331,360 people living in the total flood plain area of 250,000 ha (1992 estimate), including an estimated 44,580 households in the

1/ It should be noted that by using the average annual flood damage, the risks of flooding are evenly distributed over the life of the project. The discounting procedure inherent in the rate of return calculation assigns less importance to flood events occurring in later years of the project. The results of an exercise to simulate the random nature of flood occurrences are described in para. 11.

rural area.[2/] An estimated 43,040 occupy houses made of unbaked bricks; and the rest are made of baked bricks. The damage caused by the design flood is estimated at Rls 2.5 million and Rls 10 million, respectively, for these two kinds of construction. The damage is therefore estimated at Rls 492,000 per hectare; for the project area of 150,000 ha., this amounts to Rls 73,800 million.

8. Other Damage. Road damage is estimated at Rls 36,918 per hectare, using densities of .085 and .098 km/km^2, and repair costs of Rls 35.3 million and Rls 7.1 million per km for primary and secondary roads, respectively. Other direct losses are estimated assuming a ratio of project area damages to crop, housing and road damages of 1.3:1. This is a conservative estimate compared to the recorded ratios of 1.34:1 and 1.40:1 recorded in 1982 and 1991 events. Indirect damages, including emergency costs and costs of disruption are estimated at 20 percent of direct damages. Using these estimates and ratios, the total damage associated with the 100 year (design) flood for the project area is:

Type of Damage or Cost	Value Rls Million
Crops	23,310
Private housing	73,800
Roads	5,538
Other direct damage	34,042
Indirect damage	29,503
Total	166,193

9. The resulting figure of Rls 166,193 million is the damage associated with the design flood, discharging 2535 cubic meters per second. Table 1 shows the calculations for the average annual damages averted by the project used in the cost-benefit analysis. Average annual damage averted, at Rls 9,593 million, is the difference between the average annual damage averted by the project, and the average annual damage that would occur even with the project works (i.e., from a flood larger than the design flood). This figure is the basis for the benefit streams for damage averted, taking into account the lower values for the early years of the project when construction is not complete. The figures also include the value of improved yields from the land due to the flood control works, estimated at five percent annually over the next ten years, and remaining constant thereafter.

2/ Urban households are already protected against the design flood.

Economic Rate of Return

10. The proposed project would yield an estimated economic rate of return (ERR) of 15.0% for the base case scenario. The cost and benefit streams are shown in Table 2. The estimated ERR is considered conservative in view of the fact that the project's impact on human lives and health, on archaeological sites, and on the natural environment are not quantified. A sensitivity analysis shows the estimated return to be fairly robust, in that a worst case scenario of 20% increase in costs and a 20% decrease in benefits results in a 33% decrease in the ERR, to about 10%. An assumption of lower growth in productivity (3% per year instead of 5%), decreases the ERR to 13.1%. Under the scenario that the useful life of the project continues for only ten years after construction, the ERR would be reduced to around 11%. The ERR estimates resulting from some of the sensitivity tests carried out are as follows:-

	Cost Over-run		
Benefits Reduction	0	+10%	+20%
0	15.0%	13.7%	12.5%
-10%	13.5%		
-20%	12.5%		10.0%

11. Analysis using random flood events. The random nature of flood events was simulated in 500 computer trials. In each trial, the cumulative flood damage distribution was sampled at random for each of the 50 years of project life, and the net present values (NPV) of the 50 year stream of project benefits and costs were calculated. The benefit-cost ratio associated with the "risk" calculation, 1.88, was about 25% higher than the ratio calculated using the average annual series.

TABLE 1: AVERAGE ANNUAL DAMAGES AVERTED

Flow	Return Period (yrs.)	Annual Probability	Prob. of standard Breach Damage	Breach Damage Rls m.	Damages Without Project	Damages With Project	Without Project Average Damages	Without Project Annual Damages	With Project Average Damages	With Project Annual Damages
500	2.5	0.400	0.00	0	0	0	3656	731.2	0	0
1000	5	0.200	0.22	36562	7312	0	17283	1728.3	0	0
1280	10	0.100	0.41	68139	27255	0	45537	2732.2	0	0
1785	25	0.040	0.64	106364	63818	0	97190	1943.8	0	0
2160	50	0.020	0.82	163202	130562	0	148378	1483.8	0	0
2535	100	0.101	1.00	166193	166193	0	182813	914.1	29915	149.6
2910	200	0.005	1.00	199432	199432	59830	210234	630.7	140434	421.3
3400	500	0.002	1.00	221037	221037	221037	221037	442.1	221037	442.1
Total Annual Damages								10606.2		1013

TABLE 2: ECONOMIC RATE OF RETURN CALCULATION

(Rl '000)

year	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/2000	01/02	02/03	03/04	04/05	05/06
COSTS													
Civil Works													
Remodel feeder canal	834.4	850.6	187.4										
Niatak / Zahak	2676.6	4043.6	934.7	106.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hamun Lake	3482.2	6467.5	7229.4	7245.4	4587.6	1355.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sistan River Works	0.0	3618.6	4899.7	6133.5	4880.7	3019.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Civil Works	6993.2	14980.3	13251.1	13485.5	9468.3	4375.0							
Land	512.0	784.0	184.0	120.0									
Design and Supervision	901.5	2238.8	1998.8	1038.8	878.8	838.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Quarry	872.0	1109.8	475.7	475.7	475.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vehicles and Equipment	0.0	0.0	0.0	1880.0	1880.0	1880.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
O&M	0.0	0.0	0.0	84.4	185.4	361.4	617.4	617.4	617.4	617.4	617.4	617.4	617.4
Physical contingencies	831.6	1721.0	1472.6	1542.1	1132.3	573.4							
Total Costs	10110.3	20833.9	17382.2	18626.5	14020.6	8028.7	617.4	617.4	617.4	617.4	617.4	617.4	617.4
BENEFITS													
Crop damage averted		158.2	487.7	797.3	1127.8	1481.6	1803.0	1893.1	1987.8	2087.2	2191.5	2191.5	2191.5
Damage av. existing housing		501.0	1544.1	2524.4	3570.8	4690.8	5708.3	5993.7	6293.4	6608.0	6938.4	6938.4	6938.4
Other damage averted		446.6	1422.0	2338.5	3316.8	4363.9	5343.5	5610.7	5891.2	6185.8	6495.1	6495.1	6495.1
Total damage averted		1105.8	3453.9	5660.3	8015.4	10536.3	12854.8	13497.5	14172.4	14881.0	15625.0	15625.0	15625.0
Residual quarry value					2556.6								
Total Benefits		1105.8	3453.9	5660.3	10572.0	10536.3	12854.8	13497.5	14172.4	14881.0	15625.0	15625.0	15625.0
Net Benefits	-10110.3	-19728.1	-13928.4	-12966.2	-3448.6	2507.5	12237.3	12880.1	13554.9	14263.5	15007.6	15007.6	15007.6

ECONOMIC RATE OF RETURN 0.149799

ISLAMIC REPUBLIC OF IRAN
SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT

Flood Warning, Emergency Response and Evacuation Program

Introduction

1. Engineering works such as dikes designed to control floods can rarely, if ever, control extreme floods. Nevertheless potential damage and sufferings caused by floods can be reduced by a positive program prepared in advance to take the necessary actions during an emergency. There is thus the need to have an emergency action plan, focusing on flood disaster preparedness and prevention as an integral part of the project. The proposed plan should provide a brief review of the existing situation, and a comprehensive description of flood emergency measures. It should also include (draft) regulations concerning the responsibilities in a flood situation.

2. The Strategy in this Annex provides the conceptual framework for the proposed study. The emergency action plan should, however, be carefully designed to fit the local conditions under which it will be used. In addition, the flood loss mitigation hinges a great deal on the interest and support of the majority of the population in the flood-prone areas. This means that the local people should be aware of what the problems are and what the proposed actions are intended to achieve.

Organization of the Study

3. It is envisaged that the proposed study will be managed by the Chairman of SBRWB through the Chief of PIU. It will be carried out by the project consultants' local/expatriate specialists in active collaboration with the project staff and the provincial and local authorities. The MOE will appoint a committee composed by representatives of the concerned agencies to coordinate and review consultants' work. The committee will be chaired by an official nominated by the Ministry.

4. The study will begin during the second year of the project and its duration will be 18 months. An inception report, outlining the approach of the study, will be submitted for review after 2 months, a (draft) final report after 18 months.

Elements of the Action Plan

5. The key elements of the action plan may be placed in five broad categories:

(a) flood forecasting;
(b) flood warning;
(c) flood fighting;
(d) evaluation of damages and relief; and
(e) post-emergency activities.

Flood Forecasting

6. The hydrological emphasis in emergency measures would be in promoting by SBRWB reasonably accurate forecasts of flood conditions as soon as is practicable or desirable. The proposed study would take stock of the present problems and indicate how the flood forecasting could be improved. It should make distinction between proposals which could be implemented under the project and those which need more time.

7. It is recognized that effective and efficient flood forecasting for the Sistan river requires international cooperation, particularly between Iran and Afghanistan. If the required cooperation and active interaction were forthcoming, forecasts can be made by correlating the Hirmand river flow with the Sistan river flow, using past records or analytical models. The consultants would study this possibility and prepare a detailed proposal, including:

(a) the identification of two flow recording locations on the Hirmand river which will allow forecasts of flood crests at the head of the Sistan river at least three days in advance;

(b) the method of data transmission from each flow recording location to a nearby source monitoring center;

(c) the transmission links between the source stations and flood monitoring or reception centers to be located at Zabol and Zahidan;

(d) the methodology and coefficients, for correlating river flow at source locations to flow recording station at the head of the Sistan river;

(e) the organizational set-up for the source and reception centers: the first having a flexible framework, and the second providing for both the interpretation of flow data into the forecasts for the Sistan river and for disseminating the forecasts in the form of warnings to all concerned; and

(f) the cost estimate.

Flood Warning

8. The objective of designing a dissemination system would be to give timely warnings to the people concerned and to the organizations responsible for flood fighting and evacuating people from the flood area. The consultants would review the various methods which can be used with success in flood prone areas depending upon size and type of settlements, available communication facilities, etc. The methods may include radio, television, newspapers, telephone, visual signals, sirens and local communication facilities such as field telephone or wireless radio sets. The recommended plan would be based on available facilities and those which can reasonably be provided. It would

also provide for education of the public in the use of the flood warning system, and for its regular testing and periodic updating.

Flood Fighting

9. The consultants would prepare operational procedures for flood fighting only during the flood period. The procedures will include but not limited to the following emergency measures:

(a) the surveillance and operation of existing flood control works;

(b) the repair, strengthening, and raising of flood works to prevent their failure by overtopping, riverside and wave erosion, seepage-boils, bank slips and collapse;

(c) the building of emergency works such as secondary dikes;

(d) the deliberate breaching of a predetermined section of dike particularly along the Sistan river;

(e) the establishment of reserve stock of revetment material, jute or similar bags, etc. at critical locations; and

(f) the organizational arrangements, including the regional and local centers from which the operations can be directed and coordinated.

Evacuation and Relief

10. In this part of the study, the consultants would formulate plans for efficient evacuation and the relief of flood victims. A survey of needs arising out of a flood disaster should form the basis for relief actions. The planning should be in detail; it should also be flexible, as no two flood situations are exactly alike. Maps of areas vulnerable to floods would be made. They should preferably be simple and easily understood.

11. Planning for evacuation and relief may include:

(a) a proper and thorough evaluation of when evacuation should take place, and by whom the decision to evacuate should be made;

(b) possible places where evacuated persons should be taken and the type of shelter available or to be provided at these points;

(c) alternative routes out of vulnerable areas and to the evacuation centers;

(d) availability of transport for mass evacuation by land and water, and care of evacuated persons enroute;

(e) arrangements for supplying food, water and clothing into the disaster area;

(f) special care required for the elderly, sick and infirm people;

(g) financing for recommended operations; and

(h) public information.

12. The proposed plan should contain the organizational framework to perform the various operations required in evacuation and relief. It should specify the responsibilities of regional organization in terms of directing local operations, using regional resources and obtaining help from the provincial and national authorities as necessary. The plan should also specify at the very least: the responsibilities of key personnel; a list of other personnel specifically assigned to flood disaster operations; the training of personnel in relief operations; the availability and location of equipment; the current procedures for requesting materials and equipment; and the reporting system.

13. Finally, it should be mentioned that the effectiveness of the emergency action plan would depend upon the extent of preparation. The general elements and fundamental concepts of planning outlined above would be reviewed in the light of the consultants approach in the proposed inception report and improved as necessary. The regional authorities should encourage active participation by their representatives to ensure that the plan is in harmony with the local conditions. The review process by the coordinating and review committee would be progressive. The Bank would be furnished with the (draft) final report for its review and comments.

Post-emergency Activities

14. The proposed plan should set forth broad proposals for the post-disaster activities which should be consistent with the policies of GOI and/or the provincial authorities. These activities may include:

(a) the assessment of direct physical damages;

(b) the compilation of costs incurred on emergency actions;

(c) the rehabilitation and reconstruction; and

(d) the health problems due to floods.

ISLAMIC REPUBLIC OF IRAN
SISTAN RIVER FLOOD CONTROL WORKS REHABILITATION PROJECT

Supporting Consulting Services

General

1. The main objective of Sistan River Flood Works Rehabilitation Project, hereinafter referred to as the project, is to reduce flood losses caused by spillage from the river during high flows. The project area comprises some 250,000 hectares of land in the south-eastern part of Iran lying along both banks of the Sistan River. The Sistan Baluchistan Regional Water Board, hereinafter referred to as the Board, would be responsible for project implementation. The Board has retained the services of a local consulting firm, Tehran Sahab, as project consultants to assist the Board in the preparation of engineering designs and construction supervision. As authorized by the Board, Tehran Sahab engaged the services of an expatriate consulting firm, Nespak, to assist the local consultants in the review of flood protection plan, detailed designs of proposed flood protection works and construction supervision of the project works. Nespak prepared the "Sistan Flood Protection Project" during January 1992, participated in project appraisal and is expected to commence follow-on services by April 15, 1992 under a contract for a period of 18 months.

Services Required

2. The Board would either extend the services of Nespak if its output remains satisfactory to the Bank or would engage supporting consultants, internationally recruited and supplied by a consulting firm acceptable to the World Bank. In either case the services of the supporting consultants would be contracted under terms and conditions acceptable to the World Bank. The supporting consultants shall provide certain professional and technical services to the Board in the overall coordination and management of the project. In particular such services to the local consultants would include assistance in mathematical and hydraulic modelling, detailed designs, carrying out studies about emergency action plan and O&M, preparing procurement documents and managing and supervising construction. The supporting consultants shall report to the head of the PIU, and work in close collaboration with the local consultants.

3. The services of following specialists would be required for a total of about 200 man-months:

	Description	No. of Man-Months
(a)	Civil Engineer. Team leader, responsible for coordination and for assistance in design, procurement and construction supervision. He should have extensive experience in the design and construction of earth embankments and river training works.	48

(b) Design Engineers. Would develop design criteria for project works. Would advise and assist in planning and design of flood control works, especially with the use of appropriate computer models. Also would assist in developing bill of quantities. The design engineers should have extensive experience with the design of flood control works and the use of relevant models for hydraulic analysis. 72

(c) Construction Engineer. Would advise and assist with the construction of project works. He should have extensive experience in construction management and quality control, and with the type of construction equipment to be used. 48

(d) Short-term Specialist. Would advise and assist in solving specific problems relating to: hydrology, hydraulics, mathematical and physical modelling, river training, flood forecasting, emergency action plan, preparation of specifications and tender documents and O&M. 32

Responsibility of Supporting Consultants

4. The general scope of work of the supporting consultants would be as follows:

(a) examine all published and unpublished data and reports relevant to the project;

(b) review hydrological and hydraulic analyses, flood protection plan, designs and specifications prepared by the local consultants;

(c) develop unified design criteria and coordinate its use;

(d) review or prepare a detailed procurement schedule and work program coordinating the phasing of construction contracts;

(e) assist in the preparation of a report presenting detailed O&M procedures for project works, including recommendations for required staffing and equipment as well as for annual budgetary requirements covering staff, equipment use and maintenance activities;

(f) prepare jointly with the local consultants, specifications and tender documents for O&M equipment to be purchased for the project and for civil works to be procured under both the ICB and LCB procedures;

(g) prepare required reports and documents related to technical and engineering aspects of the project;

(h) advise and assist the Board's PIU in its:

- coordination and supervision of construction of all works to be built under the project;
- designing and conducting of M&E programs;
- liaison with the World Bank, including submission of quarterly progress reports and project completion report;
- evaluation of tenders and selection of successful tenderers;
- preparation of annual work programs;
- preparation and submission of reimbursement applications to the World Bank; and
- training and development of project staff;

(i) advise and assist the local consultants in:

- the design and periodic review of the required mathematical and hydraulic modelling;
- elaborating any additional topographical surveys and field investigations needed for design of the project works;
- reviewing hydrological data and hydrological and hydraulic analyses;
- overall planning and coordination of design and construction activities under the project;
- the preparation of plans, designs and cost estimates of the project-financed works;
- the preparation of specifications and tender documents for international and local bidding satisfactory to the World Bank;
- supervising and quality control of construction works;
- investigating the present capability for flood forecasting and making recommendations for the

establishment of improved flood forecasting systems with different degrees of complexity;

- the formulation of an Emergency Action Plan; and
- such other services which may reasonably be requested by the local consultants.

ISLAMIC REPUBLIC OF IRAN

SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT

Environmental Analysis

Introduction

1. An environmental analysis (EA) was conducted by consultants (Tehran Sahab Consulting Engineers, the Institute of Environmental Studies of Tehran University and NESPAK Consulting Engineers of Pakistan) in accordance with terms-of-reference provided by the Bank in August 1991. A report was made available prior to project appraisal and comments on its review were considered in the appraisal mission terms of reference. During appraisal, further analysis were carried out by both the consultant and the appraisal mission taking into account the Bank's pre-appraisal review comments.

Project Description

2. The project consists of rehabilitating and upgrading existing flood control works in the Sistan River and Hirmand Lake located in the Sistan-Baluchistan province in the southeast of Iran. The project would also include river training in some sections of the Sistan River, upgrading and providing bridges, a resources conservation program and an early flood warning and emergency response program, technical assistance and the provision of maintenance and laboratory equipment.

Environmental Review

3. Details on the description of the area environment, the known sites of cultural heritage importance, and a description of mitigative measures, are provided in the Environmental Analysis Report and the Master Plan Report which are in the project file and are available upon request. The environmental and social review included both the direct impact of the proposed works on the lake and land environments and cultural property, as well as environmental issues in the project area due to human settlements and economic activity. The latter was done to identify measures that would prevent environmental degradation and thus ensure the long-term sustainability of the proposed project. The various alternatives and construction methods considered were examined to determine the type and extent of impacts, if any. Detailed reviews were conducted for the least-cost alternative. The impact of sedimentation could not be assessed fully due to a lack of data during major floods which are the conditions that could result on negative environmental impacts on the wetlands. However, estimates were made to determine the order of magnitude of sedimentation problems associated with the proposed works. This analysis showed that since the floodways (Sistan and Niatak) would distribute the flood flows in two areas of the lake instead of only at one place, the Sistan river mouth, plus the fact that existing barrages in the Sistan river would operate within design hydraulic capacity, sedimentation would occur mainly within these control sections of the river. This measure would enable the removal of sediments after flood events in accordance with a well designed maintenance program to be developed under the project.

Negative Environmental Impacts

4. The main environmental concern identified by the EA was the environmental degradation that is already taking place in the project area. This condition is the result of ad hoc development and it would not be exacerbated by the proposed project. The environmental degradation is described in Annex 13 and briefly summarized as follow: (i) severe waterlogging and soil salinity; (ii) increase of weed infestation of irrigation and drainage canals; (iii) increase of water pollution in the vicinity to Zabol and large towns; (iv) increase of water borne diseases (malaria and schistosomiasis); (v) threat to fresh water quality in the lake (Hamun) due to potential discharges into it of sewage and drainage waters; (vi) threats to cultural property; and (vii) tendency to desertification.

5. Potential problems might also result from sedimentation in the floodway channels and the marginal areas of Hirmand Lake. However, these problems would always occur with or without the project.

Mitigative Measures

6. To mitigate any negative effects that might result from the deposition of sediments in the Sistan river, provisions have been taken under the project to provide maintenance equipment and to carry out a river modelling program consisting of physical and mathematical models based on data being collected, which would simulate the river hydraulics and sediment load transport to design a river training and maintenance program for the protection of such flood control works and effectively manage sedimentation.

7. The project has also made provisions to address concerns to prevent environmental degradation and threats to cultural property by including several programs (Resources Management Program -RMP) to study the extent of environmental damage and identify mitigative measures to be implemented by GOI. The proposed environmental assessments and design reviews of proposed irrigation and drainage schemes, as well as waste water and solid wastes disposal projects, would introduce a strict criteria for the analysis of projects during the planning stage as a standard procedure for future major investments in the area. The technical assistance for these studies provided under the RMP would be used to strengthen the local offices of the Department of Environment, the Cultural Heritage Organization and the Sistan Development Organization. The latter is a local agency recently established by Government in response to these concerns for the integrated planning and management of the Sistan area resources. The GOI has expressed interest and willingness to support the RMP by making available human and financial resources for the proposed project.

Environmental Review Category

8. Based on the findings and recommendations of the environmental analysis, the decisionmade at the IEPS stage was confirmed that the project should be classified under environmental category B.

ISLAMIC REPUBLIC OF IRAN

SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT

Resources Management Program

Introduction

1. The Resources Management Program is intended to address environmental degradation reported in the Environmental Analysis Report which brings forth the extent to which this issue should be considered and gives specific recommendations on mitigative measures. The report points out that environmental degradation is already taking place in the project area as a result of a number of human activities which, together with the harsh weather conditions associated with high evaporation rate and strong winds which prevail for the most part of the year, are a major threat to the economic sustainability of the area. The proposed flood works rehabilitation project would contribute positively to environmental enhancement by controlling flood waters and maintaining them confined to the dike system and the Hamun-e-Hirmand lake, a measure that would also contribute to the preservation of archaeological sites provided proper actions as recommended herein are taken to ameliorate or reverse the above-mentioned environmental degradation. This program covers the environmental degradation which requires immediate attention and the proposed mitigative measures to begin to address such concerns. The Government has expressed willingness to implement this program and to improve the management of resources in the area to ensure reversing, to the extent possible, such environmental degradation.

Environmental Degradation

2. The most significant environmental degradation taking place consist of:

(i) severe water logging, soil salinity and alkalinity which is the result of poor soil drainage and improper agricultural practices;

(ii) increase of weed infestation of irrigation and drainage canals which is further aggravated by the improper use of agro-chemicals;

(iii) increase of water pollution in the vicinity of larger towns such as Zabol due to shallow water table and poor soil drainage;

(iv) increase of water borne diseases such as schistosomiasis and malaria;

(v) threat to water quality in the Hamun lake due to potential discharges of saline drainage water and sewage from major towns;

(vi) threat to natural habitats by lack of management plans for such areas, and lack of hunting control during the migratory birds season;

(vii) threat to cultural heritage sites due to a lack of a management plan; and

(viii) tendency to desertification due to a lack of a sand dune management plan.

3. The proposed project is an essential mitigative measure to provide protection against flood damage to people, public and private property as well as to the various cultural heritage sites which are located within the Sistan river flood plain. The proposed project would also contribute positively to maintaining a water balance in the Hamun lake by keeping the flood waters within it. However, the proposed project would provide a sense of security which would promote further development. It is this development which, if not properly managed, would threaten the environmental sustainability of the entire area. The problems described above such as water logging and salinity, the potential water pollution of fresh waters and the Hamun, the threats to cultural heritage sites and migratory birds, can be directly related to the human presence and the concomitant economic development. For this reason, the prompt implementation of the mitigative measures proposed below would be of paramount importance.

Proposed Mitigative Measures

4. To properly address the environmental threats previously discussed, the following mitigative measures have been included in the proposed project:

(i) undertake an environmental assessment of the entire irrigation and drainage system to identify mitigative measures both to reduce water logging and soil salinity. This review would also include the preparation of design and procurement documents for the construction of irrigation and drainage systems and for the disposal of drainage water;

(ii) develop and implement an afforestation management plan to (a) reduce water logging by pumping ground water through evapo-transpiration; (b) control sand dune transport by serving as a wind breaker; (c) provide a source of properly managed fuel wood; and, (d) improve the scenic view of the Hamun fringes. In the preparation of this plan, consideration should be given to the selection of trees and the location where they would be planted to mitigate any negative effects. The participation of the local community would be an integral part of the program to ensure a long-term protection of these areas;

(iii) develop and implement a park management plan for the Hamun lake, which is currently reserved as a protected area;

(iv) strengthen the ongoing Government programs for eradicating malaria and schistosomiasis, improving sanitation to address water borne and vector transmitted diseases, and expanding the pest control management program;

(v) undertake environmental assessments of (a) the wastewater disposal systems for the major populated areas particularly those which are a direct threat to fresh water quality and the Hamun lake; (b) the proposed development of a storage reservoir at Chahnime depression (Reservoir No. 4); and, (c) the proposed waste disposal site located at a natural depression to the west of the project area;

(vi) design and develop a long-term environment monitoring program to be implemented by DOE, which would measure water quality and soil conditions, air quality changes, conditions of the Hamun reserve and of fauna as well as flora and cultural heritage sites, and determine the impact of proposed land developments on the natural resources; and

(vii) strengthen local Government agencies, particularly the Department of Environment, the Cultural Heritage Organization and the newly established Sistan Baluchistan Development Organization through technical assistance for the above-mentioned studies. Technical assistance would be coordinated by the PIU and implemented with the cooperation of the local Government agencies.

5. A general scope of work for each of these programs has been included in the Environmental Analysis report which would be elaborated in more detail during project implementation after undertaking preliminary surveys of conditions. The Government has expressed willingness to take more assertive actions to be implemented through a well designed Action Plan. Although this program would be implemented by local environmental experts, provision has been made to complement such work with the assistance of expatriate experts as required, and through organize visits abroad to learn from similar cases in other countries.

ANNEX 14

ISLAMIC REPUBLIC OF IRAN

SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT

Selected Documents In The Project File

A. General

A.1 Maps

B. Reports by Consultants

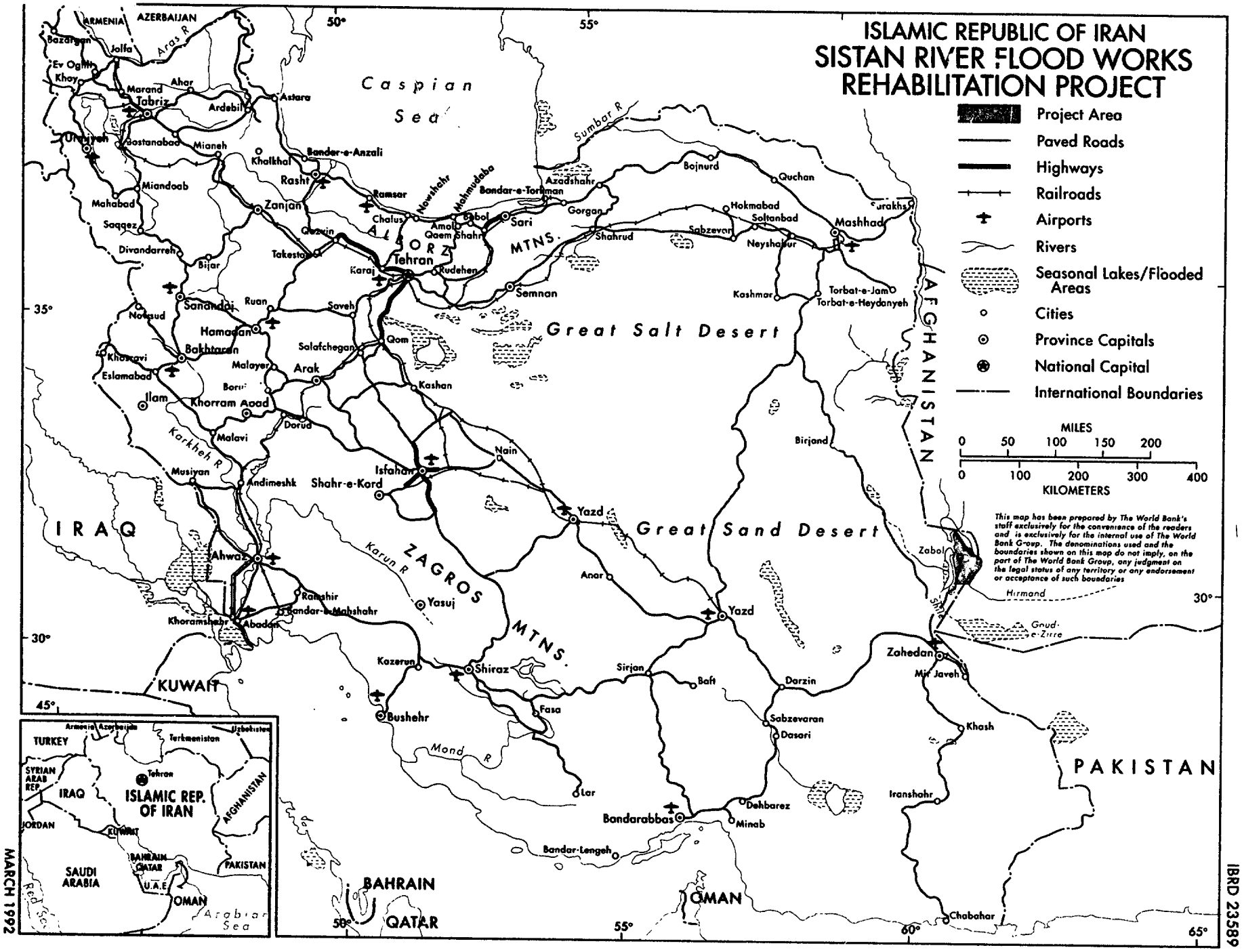
B.1 Master Planning Report, Prepared by Tehran Sahab Consulting Engineers and NESPAK Consulting Engineers , dated January 1992
B.2 Environmental Report, Prepared by Tehran Sahab Consulting Engineers and NESPAK Consulting Engineers, dated January 1992
B.3 Design Drawings, Prepared by Tehran Sahab Consulting Engineers

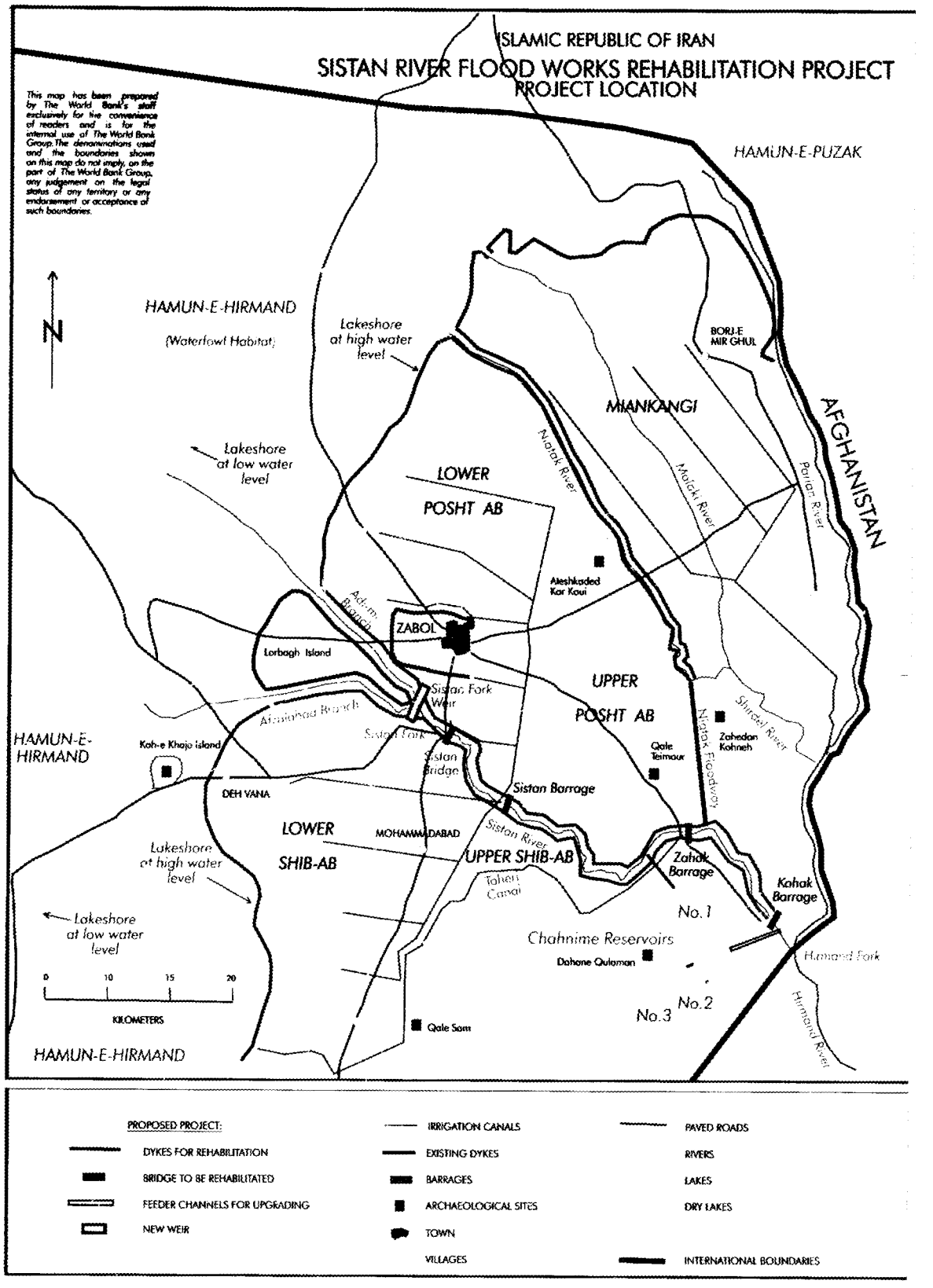
C. Project Documentation by Bank Staff

Appraisal Records:

C.1 Appraisal Mission Aide-Memoire
C.2 Design Review (by Mott MacDonald, Consultant, Dated January 1992)
C.3 Cost Estimates, Procurement Arrangements and Disbursement Estimates
C.4 Meetings Notes
C.5 Economic Analysis Calculations

MAP SECTION


ISLAMIC REPUBLIC OF IRAN
SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT
Project Area
Paved Roads
Highways
Railroads
Airports
Rivers
Seasonal Lakes/Flooded Areas
Cities
Province Capitals
National Capital
International Boundaries
MILES
0 50 100 150 200
0 100 200 300 400
KILOMETERS
This map has been prepared by The World Bank's staff exclusively for the convenience of the readers and is exclusively for the internal use of The World Bank Group. The denominations used and the boundaries shown on this map do not imply, on the part of The World Bank Group, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries
Caspian Sea
Great Salt Desert
Great Sand Desert
ALBORZ MTNS.
ZAGROS MTNS.
AFGHANISTAN
PAKISTAN
IRAQ
KUWAIT
BAHRAIN
QATAR
OMAN
Tehran
Tabriz
Mashhad
Isfahan
Shiraz
Yazd
Kerman
Ahvaz
Bandarabbas
Zahedan
Chabahar
Aras R.
Karkheh R.
Karun R.
Mond R.
Sumbar R.
Hirmand
Shirinrud
Gaud-e-Zirre
Arabian Sea
Red Sea
TURKEY
SYRIAN ARAB REP.
JORDAN
SAUDI ARABIA
U.A.E.
ISLAMIC REP. OF IRAN
Armenia
Azerbaijan
Turkmenistan
Uzbekistan
AFGHANISTAN
PAKISTAN
MARCH 1992
IBRD 23589


ISLAMIC REPUBLIC OF IRAN
SISTAN RIVER FLOOD WORKS REHABILITATION PROJECT
PROJECT LOCATION
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HAMUN-E-PUZAK
HAMUN-E-HIRMAND
(Waterfowl Habitat)
Lakeshore at high water level
BORJ-E MIR GHUL
MIANKANGI
AFGHANISTAN
Lakeshore at low water level
LOWER POSHT AB
Nyatak River
Malaki River
Poulan River
Aleshkaded Kar Koui
ZABOL
Adi-am Branch
Lorbagh Island
Sistan Fork Weir
UPPER POSHT AB
Shirkal River
Zahedan Kohneh
Qale Teimour
Nyatak Floodway
Afghanistan Branch
Sistan Fork
Sistan Bridge
Sistan Barrage
HAMUN-E-HIRMAND
Koh-e Khajo Island
DEH VANA
LOWER SHIB-AB
MOHAMMADABAD
Sistan River
UPPER SHIB-AB
Zahak Barrage
Kohak Barrage
Lakeshore at high water level
Lakeshore at low water level
Tahen Canal
No.1
Chahnime Reservoirs
Dahone Qoloman
Hamoun Fork
No.2
No.3
Qale Sam
HAMUN-E-HIRMAND
0 10 15 20
KILOMETERS
PROPOSED PROJECT:
DYKES FOR REHABILITATION
BRIDGE TO BE REHABILITATED
FEEDER CHANNELS FOR UPGRADING
NEW WEIR
IRRIGATION CANALS
EXISTING DYKES
BARRAGES
ARCHAEOLOGICAL SITES
TOWN
VILLAGES
PAVED ROADS
RIVERS
LAKES
DRY LAKES
INTERNATIONAL BOUNDARIES